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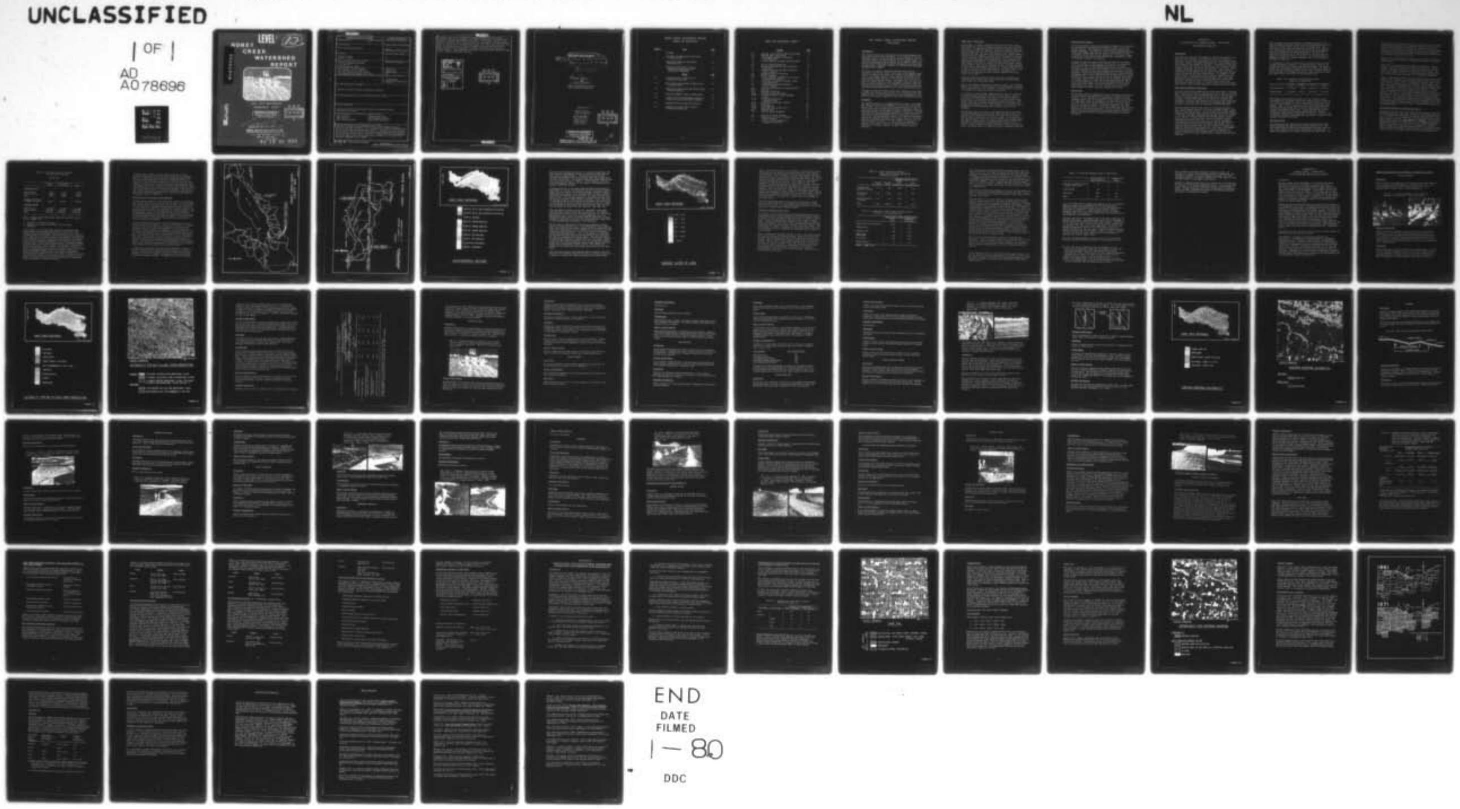

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HONEY CREEK WATERSHED REPORT

LAKE ERIE WASTEWATER MANAGEMENT STUDY

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This report concerns the relationships between farm management and water quality in the Lake Erie basin. It is presented as a public information report for the working agricultural community and as a technical report for planning agencies in the Lake Erie basin. This report was desinged for these purposes for the Buffalo District of the Army Corps of Engineers by Resource Management Associates (RMA) of West Chester, PA, as part of Phase II of the Lake Erie Wastewater Management Study (LEWMS).

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The report, as a public information document, describes how agricultural activities relate to water quality and suggests opportunities to improve water quality by changing farm management practices. Its ultimate concern is water quality in Lake Erie and it uses the Honey Creek watershed in the Sandusky River Basin as the focus for discussing these issues. The report will also serve as a model for similar reports on other watersheds within the Lake Erie basin on which programs will be implemented to develop a Lake Erie basin-wide water quality program. These subsequent watersheds will include some urban watersheds as well as other agricultural basins.

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(10) Thomas H. Cahill
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HONEY CREEK WATERSHED REPORT
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THE HONEY CREEK WATERSHED REPORT
PROLOGUE

Introduction

This report concerns the relationships between farm management and water quality in the Lake Erie Basin. It is presented as a public information report for the working agricultural community and as a technical report for planning agencies in the Lake Erie basin. This report was designed for these purposes for the Buffalo District of the Army Corps of Engineers by Resource Management Associates (RMA) of West Chester, PA as part of Phase II of the Lake Erie Wastewater Management Study (LEWMS).

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Although the Honey Creek Report deals with a primarily agricultural watershed, much of the work involved in its coordination with other agencies, data collection and presentation and promulgation to the public will be similar regardless of the type of watershed involved.

Background

The legislative basis for the LEWMS Project is found in the Federal Water Pollution Control Act Amendments of 1972, Public Law 92-500, Section 108d. That section directed the Secretary of the Army "to design and develop a demonstration wastewater management program for the rehabilitation and environmental repair of lake Erie." Section 108d requires that the program be developed in cooperation with EPA and other interested Government bodies at the Federal, state and local level. The demonstration program is to "set forth alternative systems for managing waste water on a regional basis and shall provide local and State Governments with a range of choice as to the type of system to be used . . ." This report was prepared in response to that part of Section 108 that requires the Corps to include in its program, measures to control diffuse sources of pollution.

LEWMS Phase II Objectives

During Phase I of LEWMS, conducted during 1974 and 1975, a large scale program of tributary sampling was carried out across the Lake Erie Basin. In addition, existing information on various sources of pollution to the lake was analyzed. The major finding of the Phase I Report (LEWMS, 1975) was that large quantities of pollution were carried to the lake from land runoff during storms. Solids, derived from the land and suspended in runoff water, accounted for the bulk of this pollution. These solids settle out in the lake, an adverse impact on fish spawning, lake transportation, water treatment and recreational opportunities. Plant nutrients, leached by rain from land surfaces or carried by eroded soil, fertilize nuisance aquatic plant growth in Lake Erie and tributary rivers. The death and decay of this aquatic plant growth contributes to serious oxygen depletion in parts of Lake Erie during summer months. Excessive aquatic plant growths also affect the use of Lake Erie by interfering with recreation and impacting on water treatment processes and on the fishery of the lake.

Among nutrients entering Lake Erie in land runoff, phosphate has received special attention as the key substance affecting aquatic plant growth (IJC, 1974; FWPCA 1968).

Based on the general agricultural character of many of the tributary basins, the available water chemistry information suggested strongly that a major portion of this phosphate is of agricultural origin and is transported in association with soil particles.

As a result of these findings, LEWMS decided to focus its attention on the pollutants washed into Lake Erie by land runoff. Phase II activities of LEWMS include intensive water quality and quantity monitoring in 72 tributaries, development of a land resource information system and hydrologic and chemical modelling efforts. These efforts will lead to a better understanding of how pollutants are generated and delivered to the lake. However, it was apparent that a program which would ultimately use the results was yet to be designed.

Specifically, there is a need to communicate how natural processes and farm management affect Lake Erie. This information must be communicated to the farmer in a way that will alert him of the water quality issues involved and to his role in them. In the context of the Lake Erie Basin, there is a need to identify and recommend those agricultural practices that will improve water quality and to indicate where such practices are appropriate with respect to farm income. Finally, there is a need to illustrate, across the Lake Erie Basin, the present degree of acceptance of the recommended practices.

Data Sources for Report

In this report, water quality data analyzed in Chapter 1 is taken from the stream monitoring program of Heidelberg College funded by the Buffalo District. The description of agricultural practices and agencies (Chapter 2) is based on a review of many documents published by SCS, EPA, OARDC, ODNR, and OSU, and on conversations with many individuals in these agencies and institutions. In Chapter 3, agricultural practices used in Venice Township were revealed by a survey of 26 farmers living in the township.

Although the survey of farmers provided much detail on farm operations with respect to water quality, the survey is not a practical way to collect data on farm management on the level of detail required by a report of the nature proposed here. Descriptions of practices used and estimates of frequencies of their use in a region are better provided by county-level agricultural technical assistance personnel. Remote sensing imagery-LANDSAT and high altitude infrared photography can be used to distinguish conventional from conservation tillage practices, to show the use of contour cropping, and to identify crops. These remote data sources can be processed by computer or screened manually to provide basin-wide descriptions and maps of the practices mentioned. Not only can information obtained from county agriculture experts and remote sensing be used for success monitoring in the report, but it is also valuable to the water quality modelling efforts currently underway by the Corps.

Expectations

The Lake Erie Wastewater Management Study is interested in having put to use the monitoring experience it has gained in nonpoint source analysis. We are interested in integrating our efforts with other concerned agencies for the improvement of water quality in Lake Erie. We present this report as an example of how these interests can be met. The report is necessarily incomplete since one of its objectives is to stimulate interest and receive suggestions from other agencies and from the public. We are keenly aware that this is a new direction for the Corps of Engineers, but its evolution seems both a logical and necessary addition to the existing program in order to achieve the basic objective of improved water quality in the Lake Erie Basin.

CHAPTER I
THE EFFECTS OF AGRICULTURAL ACTIVITIES ON WATER QUALITY

Introduction

This report is concerned with measures to improve the quality of the nation's water resources. The condition of all water bodies is important, from the smallest headwater streams to the largest rivers and lakes. However, the present discussion will focus primarily upon Honey Creek and its relation to Lake Erie. The quality of Lake Erie and its value to the region are affected not only by human activities along the shoreline, but also by the condition of the various rivers, streams, and ditches which drain into the lake. These tributary streams are in turn affected by activities on the land that may take place some distance away from surface waters. The emphasis of the present report is upon agricultural activities--specifically, agricultural land use in the Honey Creek Watershed. This report will demonstrate how agriculture in the Honey Creek Basin affects Lake Erie; will indicate the costs to the region which result from degraded water quality; and will discuss in detail some of the steps that could be taken to reduce agricultural impacts on surface waters.

Water Quality Problems in Lake Erie

Lake Erie has played an important role in the development of northern Ohio by serving as a means of transportation and a source of food and water. Historically, the lakeshore marshes and the numerous bays and tributaries have provided an excellent habitat for fish and other wildlife. Economic development of the region has increased man's dependence on the lake, particularly as a source of water supply and recreation. However, human activities have degraded the quality of the water to the point that its value has seriously diminished.

Lake Erie waters contain a wide variety of polluting substances, which include organic materials, nutrients, sediment, metals, pathogens, and pesticide residues. One of the most serious water quality problems at the present time is caused by excessive nutrient loadings to the lake. Nitrogen and phosphorus compounds, which are valuable on the land due to their essential role in plant growth, become a severe nuisance in surface waters when their abundance promotes overgrowths of aquatic plant life. Due to nutrient enrichment (eutrophication), the annual production of algae in Lake Erie has increased nearly 20-fold since 1919 (Regier and Hartman, 1973). Algae growths have caused taste and odor problems in drinking water supplies, reduced the recreational value of the lake, and fundamentally altered its biological balance. A major consequence of nutrient enrichment is that decomposition of dead aquatic plant material depletes the oxygen supply needed to support fish and other organisms.

Other problems involve large amounts of sediment delivered to the lake by tributary streams. Soil particles are detached from the land surface by rainfall impact and the force of flowing water. Once transported to the lake, these materials settle out on the lake bottom. The sediment deposits thus created may smother fish spawning areas and clog harbors and navigation channels. The materials remaining in suspension add to the turbidity of the water and thus affect the recreational value of the lake. As is discussed below, sediment also plays an extremely important role in the transport of nutrients to Lake Erie.

It is difficult to place a dollar value on the total cost to society of water pollution in Lake Erie. An important direct outlay is the expenditure required to combat siltation of waterways. The actual annual costs of dredging at Cleveland and Toledo Harbors are given in Table 1-1A. These figures represent only the cost of annual operation and maintenance of the dredging activities. Many millions more have been spent in the construction of diked disposal areas.

Table 1-1A - Annual Cost of Dredging Activities - Operation and Maintenance

	FY 76	FY 76T	FY 77	FY 78
	$	$	$	$
Cleveland Harbor	3,152,606	43,388	2,644,716	2,632,222
Toledo Harbor	1,000,783	142,012	2,154,765	1,715,519

Water quality deterioration has been one of the critical factors responsible for a 78 percent reduction in annual value of catches by U. S. Lake Erie fisheries--a loss of more than $5 million in current dollars--from the 1940's to the late 1960's (GLBC, 1975; Regier and Hartman, 1973). It is calculated that the Erie, Pennsylvania resort area loses $13,000,000 per year in tourist trade because of water quality deterioration (GLBC, 1975). Losses elsewhere due to beach closings, increased water treatment requirements, and foregone recreational opportunities are difficult to estimate. The total cost of Lake Erie pollution, when added over many years, is clearly in the hundreds of millions of dollars.

Pollutant Sources

The pollutant sources responsible for these problems are dispersed widely throughout the land area which drains into Lake Erie. The most obvious sources, which have received almost exclusive attention until recent years, are the direct discharges of municipal and industrial wastewater into streams, rivers and the lake itself. The

appropriate corrective measures for these "point sources" are fairly clear--namely, construction of additional treatment facilities for removal and stabilization of pollutants. Massive steps in this direction are presently being taken. As of the end of 1976, approximately one billion dollars in Federal grants have been awarded to municipalities in the Lake Erie Basin for planning and construction of wastewater management facilities.

Lake Erie is also affected very seriously by "nonpoint" or diffuse sources, which involve general contamination of water as it drains from the land.

Unlike the case of municipal and industrial wastewater, chemical methods of pollutant removal are usually not feasible for nonpoint sources. Instead, inputs of these undesirable materials must be reduced by changing the manner in which the land is treated. The focus of the present report is upon land management measures which can reduce agricultural pollution in the Honey Creek Watershed.

Table 1-1 indicates the total pollutant loads delivered to Lake Erie. (LEWMS, 1975). Emphasis is placed upon phosphate since this is the nutrient most closely linked to overgrowths of aquatic plants in the lake. Primary nonpoint sources of pollutants include urban runoff, agriculture, on-site domestic waste disposal, and solid waste disposal. In addition, some materials can be contributed by natural processes that would occur with or without man's presence. In many cases, the absolute magnitude of the various nonpoint sources is unknown. However, unit area phosphate loads are similar for the primary nonpoint sources. Since agricultural activity is the predominant land use in the Lake Erie Basin, especially northwest Ohio, agriculture is the predominant nonpoint source of phosphate loadings to Lake Erie. Detailed data illustrating the dominant role of agricultural phosphate loadings in Honey Creek are presented below. This information presented for Honey Creek is representative of any area in northwest Ohio.

Water Quality Effects of Agricultural Activity

Agricultural pollution can result from both the growing of crops and livestock operations. Since crop production is the predominant land use in the Honey Creek watershed, the present discussion will focus upon the effects of crop production. Agricultural pollution results from two basic processes: soil erosion and leaching. Soil lost from farm fields becomes a pollutant when it is transported through the surface water system. In northern Ohio, soils composed primarily of small particles are easily carried by flowing water to surface waters. Conventional cropping practices promote soil erosion by providing minimal ground cover, so that the soil is essentially bare for much of the year. Leaching refers to dissolution of chemicals in

Table 1-1 - Pollutant Inputs to Lake Erie for June 1974 to May 1975

Metric Tons

	Detroit River	Other Inputs to Lake Erie	Total
Phosphate (as P)[2]			
Point Sources	4,813	3,749	8,562
Diffuse Sources	2,497	6,214	8,711
Total	7,310	9,963	17,273
Nitrogen (excluding organic nitrogen)	86,600	131,400	218,000
Suspended Solids			
Point Sources	100,000[3]	40,000[3]	140,000[3]
Diffuse Sources	2,170,000	6,420,000	8,490,000
Total	2,270,000	6,460,000	8,630,000

Note: Loadings exclude atmospheric inputs and shoreline erosion
Source: LEWMS, 1975

1. One Metric ton equals 1.102 tons.
2. Figures do not include 2,334 MT/yr from Lake Huron.
3. Estimated.

soil by water. In the Honey Creek watershed, leached materials reach surface waters through the network of tile drains. Tile drainage may also be responsible for a proportion of soil loss. A critical aspect of the pollution problem is application of materials on the land, namely fertilizer, manure and pesticides. Nutrients and other compounds contained in these materials become either leached into the soil or attached (adsorbed) to soil particles, which subsequently reach surface waters through erosion. Phosphate possesses a strong affinity for soil particles and thus tends to become bound quickly in particulate form. However, in some areas of northern Ohio, overfertilization has occurred to the extent that all available sites for phosphate adsorption have been filled, resulting in increased phosphate concentrations in groundwater (Cooperative Extension Service Bulletins 472 and 561, OSU). Phosphate losses also occur because of failure to incorporate fertilizer in the soil and because of application during the winter months when frozen ground limits incorporation by natural processes.

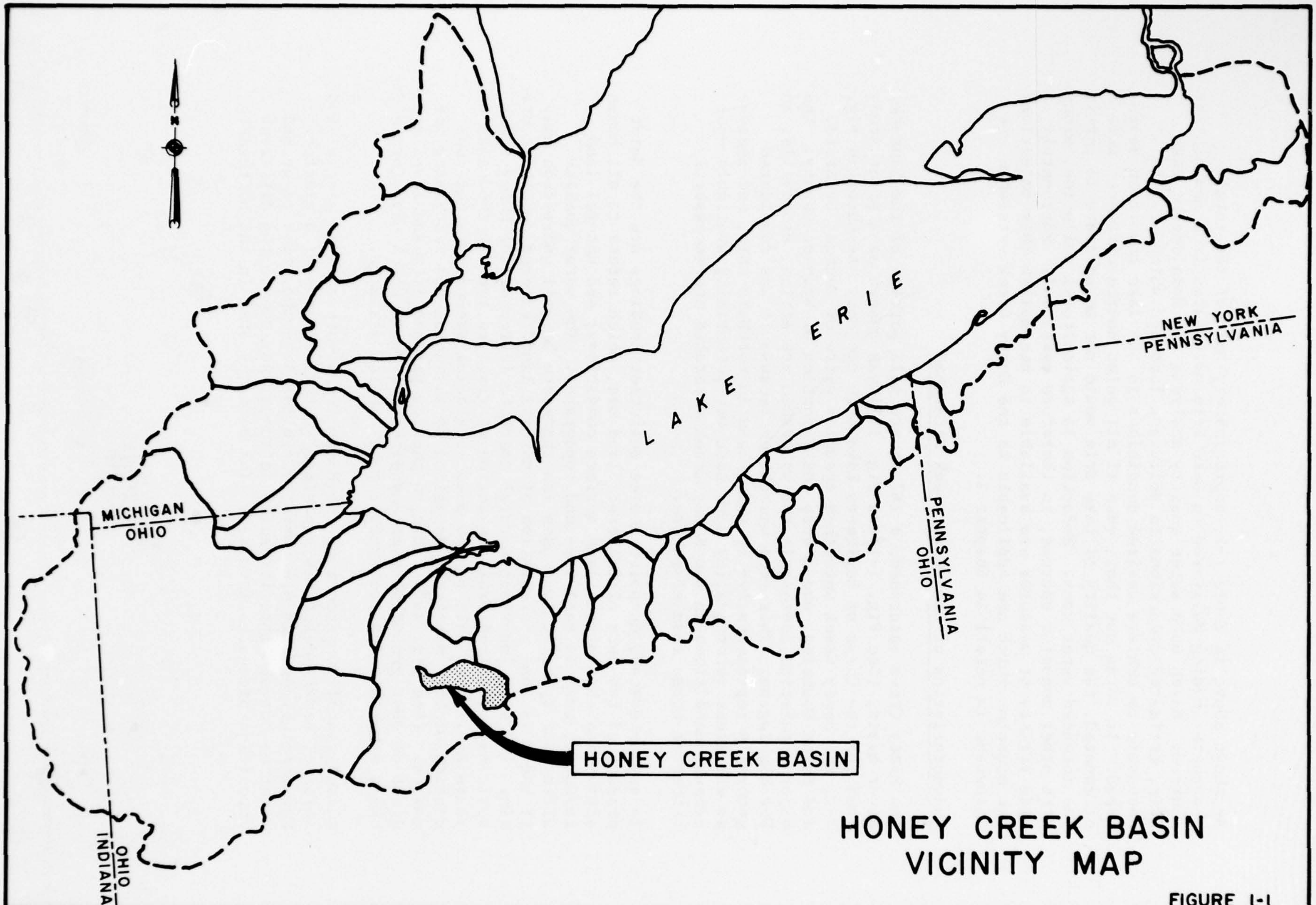
As shown above in Table 1-1, approximately half of the total phosphate loading delivered to Lake Erie originates from nonpoint sources. Based upon water quality analysis and modeling of Lake Erie, estimated reductions in pollutant loadings which will be necessary to achieve desired conditions in the lake have been developed. It turns out that, even if all point source effluents were eliminated, the quality of Lake Erie would not be adequate to permit the intended water uses. Reduction in agricultural pollution, along with other nonpoint sources, is therefore essential. Fortunately, a wide variety of measures are available to accomplish this objective. The measures which are applicable to the Honey Creek watershed are discussed in detail in Chapter 2.

Characteristics of the Honey Creek Watershed

The Honey Creek watershed, a 187 square mile portion of the Sandusky River basin, (See Fig. 1-1 and Fig. 1-2) was chosen as a pilot study area for the Corps of Engineers Lake Erie project. As shown in Fig. 1-2, the Honey Creek watershed occupies parts of Seneca, Crawford, and Huron Counties, and a very small portion of Wyandot County. The major population centers in the watershed are Attica, Bloomville, and New Washington. This area was chosen because it was considered generally representative of rural land in northern Ohio, and because an excellent water quality data base was potentially available--not because conditions in the Honey Creek watershed are necessarily better or worse than elsewhere.

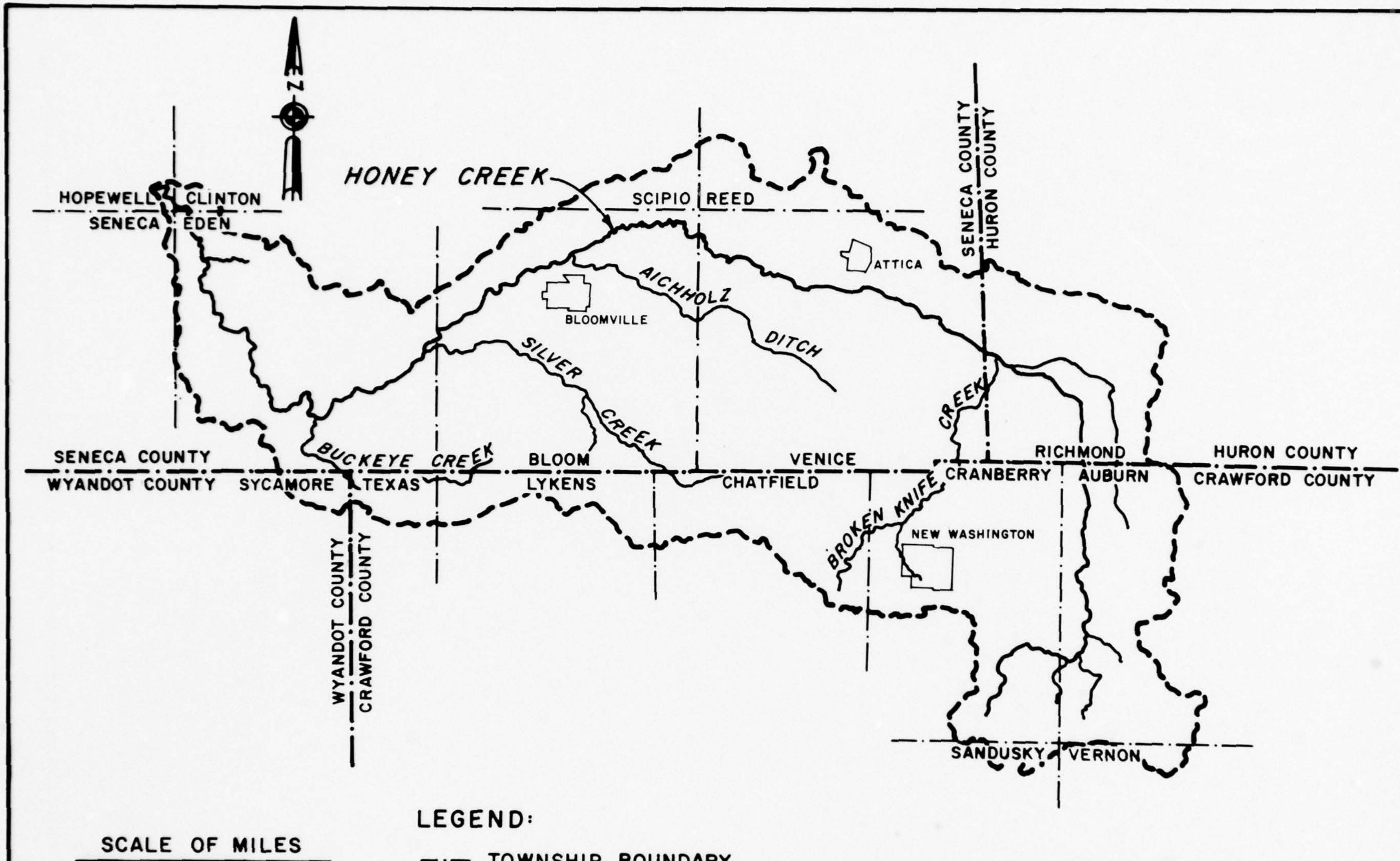
In any watershed, nonpoint source pollutant loadings are the joint product of two sets of factors: land use, which refers to all human activities that affect land surface conditions; and natural land features, such as soil type and topography. The water quality effects of specific land uses can therefore be well understood only if there is some appreciation of natural land features and their origin. The most important natural characteristics of the Honey Creek basin have resulted from the action of glaciers tens of thousands of years ago. Over half of the area is glacial ground moraine, consisting of till materials deposited by advancing and retreating ice masses. (See Fig. 1-3). Due to the low permeability and level gradient of most ground moraine deposits, the soils which have formed in these materials tend to exhibit poor natural drainage.

An additional 20 percent of the Honey Creek watershed is glacial end moraine, namely materials deposited at the terminus of a glacier. End moraine deposits are normally similar in composition to ground moraine, but are more irregular in topography due to the different deposition processes involved. The hummocky area in the northeast



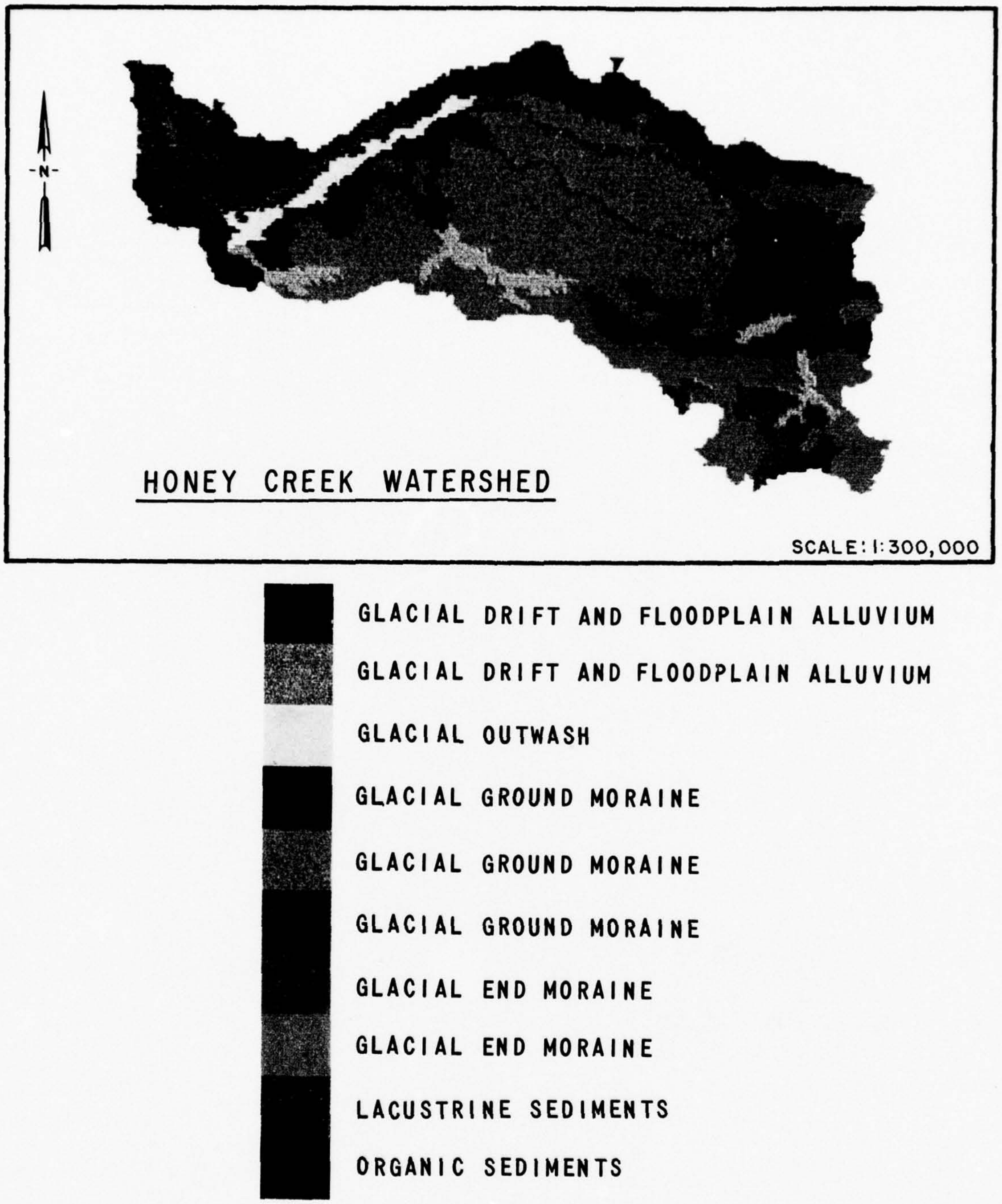
HONEY CREEK BASIN
VICINITY MAP

FIGURE I-1



HONEY CREEK BASIN

FIGURE I-2



PHYSIOGRAPHIC REGIONS

FIGURE I-3

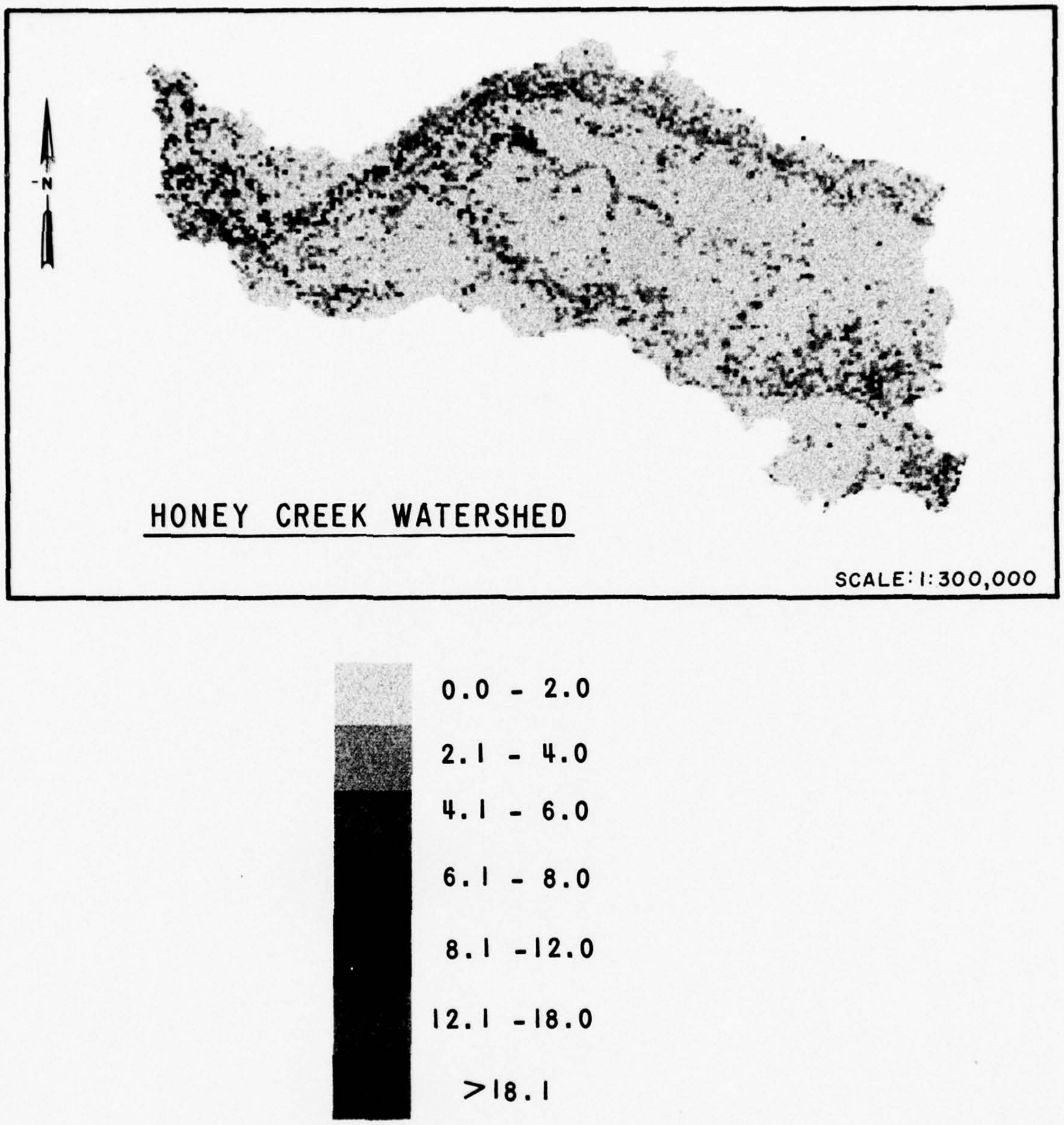
portion of the watershed near Attica is a typical end moraine. Two other important physiographic areas are lacustrine (lake) deposits and alluvial (stream) deposits. The lacustrine deposits have resulted from sedimentation in post-glacial lakes that formed after the final glacial melt. The materials comprising these deposits tend to be very level and fine in texture. Alluvial deposits, the most recent physiographic feature, are the result of stream deposition of material eroded from uplands.

The geologic history of the Honey Creek watershed is thus directly responsible for the key land characteristics affecting water quality, namely fine soil texture, poor natural drainage, and gentle slopes. Approximately 94 percent of the watershed soils, by area, consist of relatively fine-textured silty clay loam, silt loam, and silty clay, surface soils. Poor natural drainage is indicated by the fact that the seasonal high water table--usually occurring in early spring--is at the land surface in 25 percent of the watershed, and is less than 1.5 feet below the surface in another 60 percent of the area. More than two-thirds of the land has less than 2 percent slope; and well over 95 percent has slope less than 6 percent. (See Fig. 1-4).

Given the natural fertility of the soil, conversion of the Honey Creek watershed to agricultural use was inevitable. The present distribution of land use in the 187 square mile area is: 81 percent agricultural land, 11.5 percent brush and woodlands, 3 percent wetlands and surface water, 2 percent roads and railroads, 2 percent residential land, and 0.5 percent other urbanized land. Agriculture is thus overwhelmingly predominant in the watershed.

The two aspects of agriculture which are most important to water quality on an ongoing basis are: (1) harvesting and tillage operations which leave the land surface largely devoid of cover during the winter and spring months, and (2) application of fertilizers in order to maintain soil productivity. A critical interaction involving natural land characteristics is that, in the absence of land cover, the fine-textured soils found in the watershed are easily detached and cast into suspension by raindrop impact. The land thus tends to be erodible when converted to agricultural use. The general wetness of the land also plays an important role, by assuring that a large proportion of precipitation during the winter and spring months will emerge from the watershed as direct runoff. This affects the loadings of both particulate and soluble materials carried by Honey Creek.

The gentle land slopes in the watershed serve to moderate soil erosion, and can be credited with the fact that soil loss is usually not so great as to reduce the long-term productivity of agricultural



PERCENT SLOPE OF LAND

FIGURE 1-4

land. The fact that erosion is nevertheless a serious water quality problem can be attributed to the persistence of the fine-textured soil particles once in suspension, and the high phosphate content of these particles. The tile drains installed under much of the land in the basin to combat wetness plays significant and complex role in the impact of agricultural activities on water quality. Both negative and positive impacts are realized. On the negative side, tile drainage, by intercepting percolate water, short circuits soil purification processes and increases the loading of nitrogen. On the positive side, tile reduces soil moisture more rapidly than natural drainage. Lower soil moisture reduces the opportunity for surface runoff when new rainfall occurs. Reduction in surface runoff reduces sediment and phosphorus contributions to the surface waters. Overall sediment and phosphorus reductions obtained with tile drainage are more significant to Lake Erie water quality than any increases in nitrogen loading.

This brief discussion should indicate that the pollutant loadings carried by Honey Creek, and the ultimate effects produced in Lake Erie, are the outcome of a complex interplay between man's use of the land and its various natural characteristics.

Pollutant Loadings in Honey Creek

An excellent record of water quality in the Sandusky River basin has been yielded by the work of Heidelberg College investigators (Baker and Kramer, 1974). Sampling of Honey Creek and its tributary streams as part of the current Corps of Engineers project began in January 1976. A detailed eighteen-month record for Honey Creek at Melmore is presently available. This record includes observations every 6 hours during high flow periods and every 24 hours during dry weather. This record makes it possible to demonstrate that agricultural activity is the predominant source of phosphate and suspended solids loadings in the watershed.

Table 1-2 summarizes the total loadings of water constituents carried by Honey Creek during the sampling period. Dates within this interval have been categorized into three groups based on hydrologic conditions, namely: .snowmelt/thaw periods, storm periods, and nonstorm periods. The periods of storm runoff comprised only 18 percent of the sampling interval in terms of days, but accounted for more than half of the total volume of water discharged by the stream. The storm periods also accounted for 46 percent of the dissolved orthophosphate load, 80 percent of total phosphate, and 92 percent of the suspended solids load.

Table 1-2 - Water Constituent Loadings in Honey Creek at Melmore During 1976 Observation Interval

	Runoff in inches	Suspended Solids	Loading in Metric Tons: Soluble ortho phosphate as P	Loading in Metric Tons: Total phosphate as P
Snowmelt/thaw periods (19 days)	1.75	740	1.36	3.6
Storm events (33 days)	4.53	17,190	1.75	27.2
Nonstorm periods (130 days)	1.76	710	0.66	3.1
TOTAL	8.04	18,640	3.77	33.9

Table 1-3 - Comparison on Honey Creek with Nearby Rivers in Terms of Total Phosphate Load

	Annual Load of Total Phosphate as P: Metric Tons	Annual Load of Total Phosphate as P: Kilograms Per Hectare
Maumee River (at Waterville)	2,233	1.37
Portage River	112	1.01
Sandusky River	499	1.54
HONEY CREEK	45	1.17
Huron River	122	1.27
Vermilion River	75	1.11

SOURCE: LEWMS, 1975.

The total phosphate loading during the sampling interval was 33.9 metric tons as P. Based upon an analysis of hydrologic events and loading relationships, it was determined that the total phosphate loading in a typical year would be between 40 and 50 metric tons as P. Assuming an average value of 45 metric tons, this amounts to 1.17 kilograms of phosphate as P per hectare of land draining into Honey Creek above Melmore. Table 1-3 compares Honey Creek with nearby rivers in terms of phosphate loading. When the figures are converted to a yield per-area basis, Honey Creek is clearly typical of rivers in northwest Ohio.

The sources of particulate phosphate in the load from the Honey Creek Basin is derived from several principal sources, including: native soil P, P from fertilizer, manure and domestic waste, and P from crop residues and detritus.

The mass balance for a major portion of the Honey Creek phosphate input is shown in Table 1-4. The major nonagricultural source of phosphate which must be considered is domestic wastewater. Phosphate in the wastewater from households and business establishments can be transmitted to surface streams by three mechanisms: (1) release of treated sanitary effluent; (2) overflow and leakage from sanitary and combined sewers; and (3) release of untreated or treated waste from on-site septic systems to ditches or tile systems. Existing Honey Creek records do not describe adequately the loadings from any of these sources. A maximum figure can be computed, however, by making the extreme assumption that all phosphate generated by households, commercial establishments, and institutions is released directly to surface waters with no treatment whatsoever. The quantity of phosphate involved would be approximately 15 metric tons per year.[1/] It is clearly an overestimate to assume one hundred percent yield of this phosphate since all municipal sewage treatment plants provide at least some phosphate removal, and since on-site systems (which receive the bulk of wastewater in the Honey Creek watershed) usually yield only a portion of their phosphate inputs to surface waters, even if malfunctioning.

There is very little industrial activity in the Honey Creek watershed. There are no known discharges of industrial waste to surface waters. Other potential sources of phosphate such as silvaculture, construction activity, mining, landfills, and atmospheric fallout should be insignificant, given the prevailing patterns of land use.

[1/] The phosphate content of raw sewage averages about 10 mg/l. The typical volume of municipal wastewater is 100 gallons per capita per day, which includes an allowance for business establishments; and the population residing in the Honey Creek watershed is approximately 10,800 persons.

Table 1-4 - Potential Phosphate Inputs to Honey Creek

	Annual Input in Metric Tons as P	Percent of Total
Load due to domestic waste (upper limit value)	15	2
Animal Manure	48	8
Fertilizer	568	90
TOTAL	631	100

Part of the agricultural loading could possibly be due to livestock operations rather than crop production; the livestock wastes generated within the watershed each year contain approximately 48 metric tons of phosphate.[1/] However, given present livestock management practices, i.e. manure holding facilities and manure spreading, most of the manure which would reach the stream has to be associated with crop production.

The other main source of phosphate input to the Honey Creek Basin is chemical fertilizers. Approximately 568 metric tons of phosphate as P[2/] are applied in the Honey Creek Basin above Melmore. From Table 1-4 it can be seen that a total of 631 metric tons of phosphate as P are applied to the land in the Honey Creek Basin. The bulk of the sediment phosphorus is native soil P except where additions of manure have been heavy over many years. Normal fertilizer phosphate additions increase the total P content of the soil about 0.5 percent per year, but may affect the extent to which soil phosphate is released into solution (Logan, 1978).

The plant available phosphate content of soils in the Honey Creek Basin has increased 230 percent (from 20 to 46 lbs/acre, mean of

[1/] A unit area load of 0.324 metric tons of phosphate as P per square mile was developed from Seneca and Crawford Counties unit area loads developed from Great Lakes Basin Material Usage Inventory (for 1972). Huron County unit area estimates prepared by applying P_2O_5 per annual for Seneca County to 1969 livestock counts for Huron (from U. S. Census of Agriculture).

[2/] Based on an average application of 3.81 metric tons per square mile to 149 square miles. From Seneca and Crawford Counties usage in Great Lakes Basin Material Usage Inventory (1972).

Huron, Crawford, and Seneca Counties) from 1961 to 1976. The increase is a result of soil phosphate buildup recommendations and the desire of farmers to achieve maximum crop yields. The total phosphorus content of the basin's croplands is in the range of 1,200 to 1,600 lbs/acre in top eight inches of soil.

Erosion of cropland removes only a tiny fraction (0.1 to 0.2 percent per year) of the total soil phosphorus content. The fertilizer input to the basin is not therefore directly related to basin phosphate output. However, excessive application of phosphate fertilizer may affect the forms of phosphorus transported and improper application may result in preferential transport.

CHAPTER 2
AGRICULTURAL PRACTICES THAT REDUCE WATER POLLUTION

Introduction

One main purpose of farm management is to increase farm income directly by increasing crop yields or reducing fixed costs. Agricultural research at Ohio State University and at the Ohio Agricultural Research and Development Center (OARDC) develops and tests new methods of farm management. A new method will be recommended for use only after its effect on farm income and its use in various situations are known. Certain of these methods have important consequences for water quality. Examples are: tillage modifications or reduction of fertilizer and pesticide application rates, based on soil tests or knowledge of pest life cycles and on new methods of chemical application.

Besides increasing farm income, another purpose of new techniques in farm management is to protect the long-term productivity of the soil. Protecting soil productivity is fundamental for those who rightly see farming as a continuing and necessary human activity. Protection of soil resources from the effects of erosion, compaction, flooding, and other stresses is related to the effects of soil cultivation on water quality downstream from cropland. Often an innovative farm management practice, where used, will protect both soil and water resources. Although many agricultural practices that protect soil resources have a positive effect on farm income, others represent a cost to the farmer in the short term. Certain of these practices may be cost shared by the Agricultural Stabilization and Conservation Service after technical review of adequacy by the Soil Conservation Service.

Agricultural methods that have a positive effect on water quality are described in the sections that follow.

Each method is reviewed for its purpose, rationale, and applicability; its advantages and disadvantages; its equipment requirements; and its impact on water quality. Photographs and sketches are used to illustrate various practices. Following the review of farm management practices, Government agencies providing educational, technical, and financial assistance to the farm community in Honey Creek are identified and their range of services discussed. Opportunities to improve water quality and protect soil through farm management will be determined by techniques suitable to land and farm income expectations. Actual use of new techniques will be influenced by economic considerations.

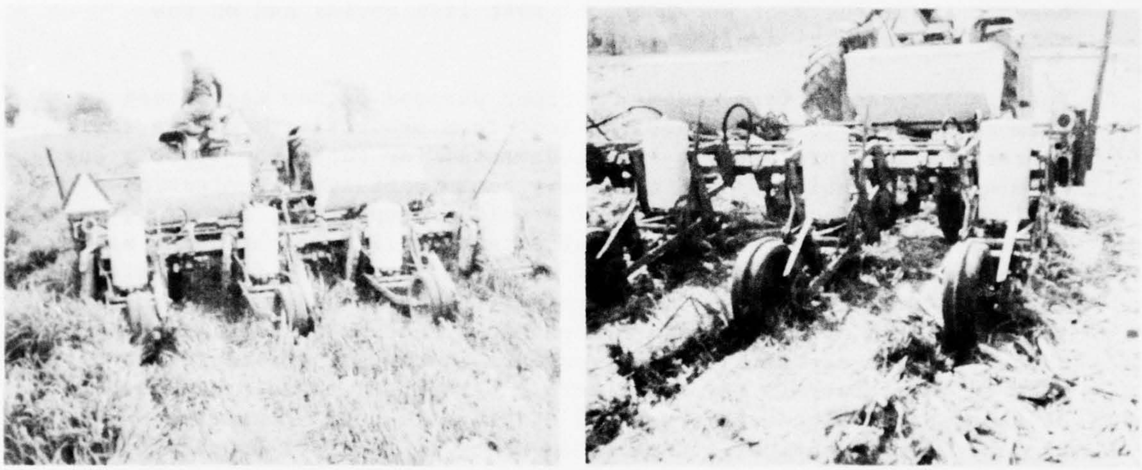
AGRICULTURAL PRACTICES WITH A POTENTIAL FOR REDUCING SOIL LOSSES

NO-TILL PLANTING

Description

No-till refers to the planting of row crops in narrow slots opened in the soil without any other physical disturbance of the soil. The crop is planted in crop residue from the previous year or in chemically-killed winter cover or meadow vegetation.

FIG 2-1. a. No-till planting in sod; b. No-till planting in corn residue. (photos: OSU/OARDC)

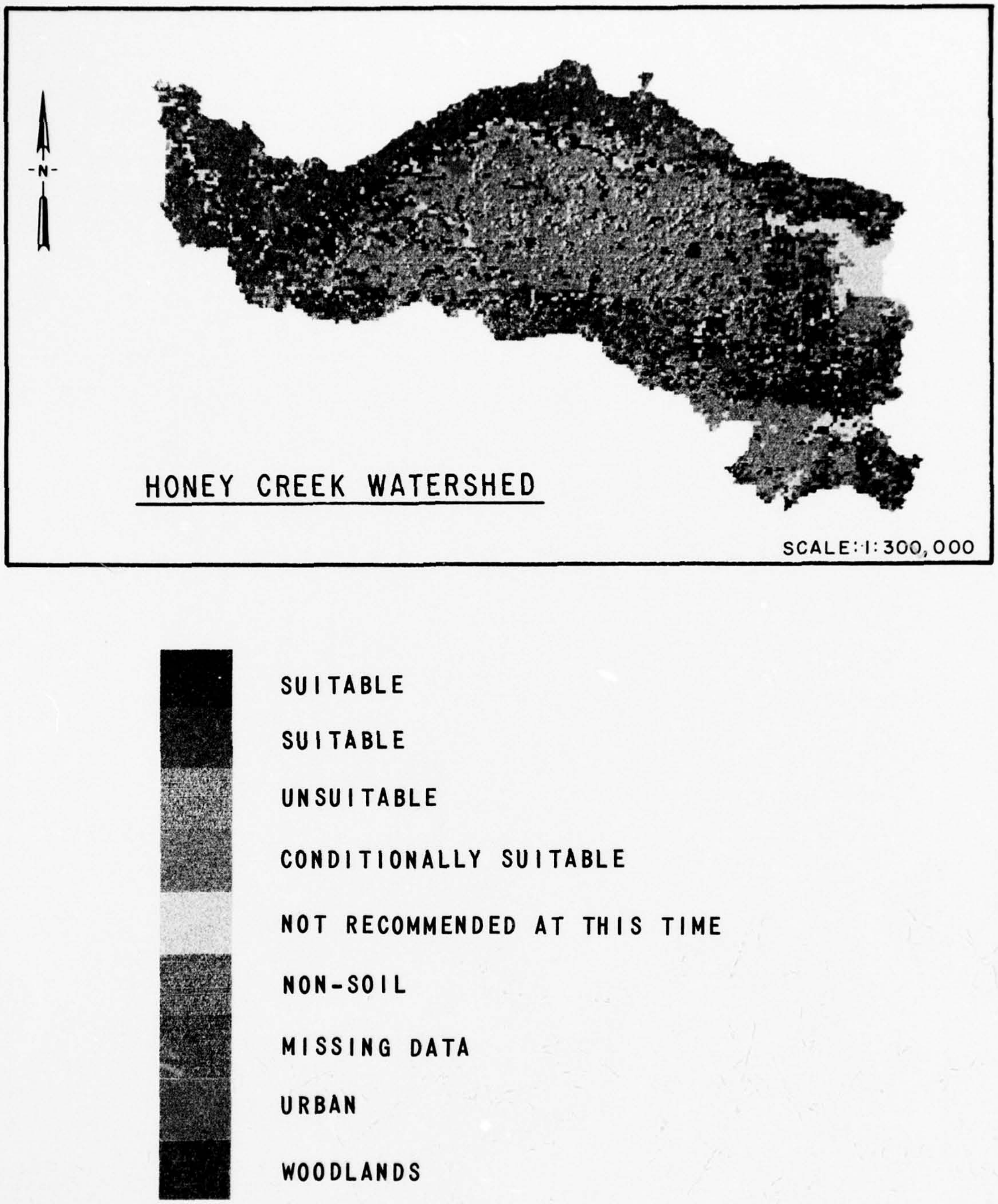


Purpose and Rationale

No-till planting is designed to reduce soil erosion by minimizing disturbance to soil structure and by permitting crop residue or winter cover during the erosion-sensitive winter and spring months. It is effective in conserving soil moisture during dry periods by maintaining soil structure conducive to infiltration, since it prevents sealing of soil surface with fines and reduces soil compaction due to farm machinery.

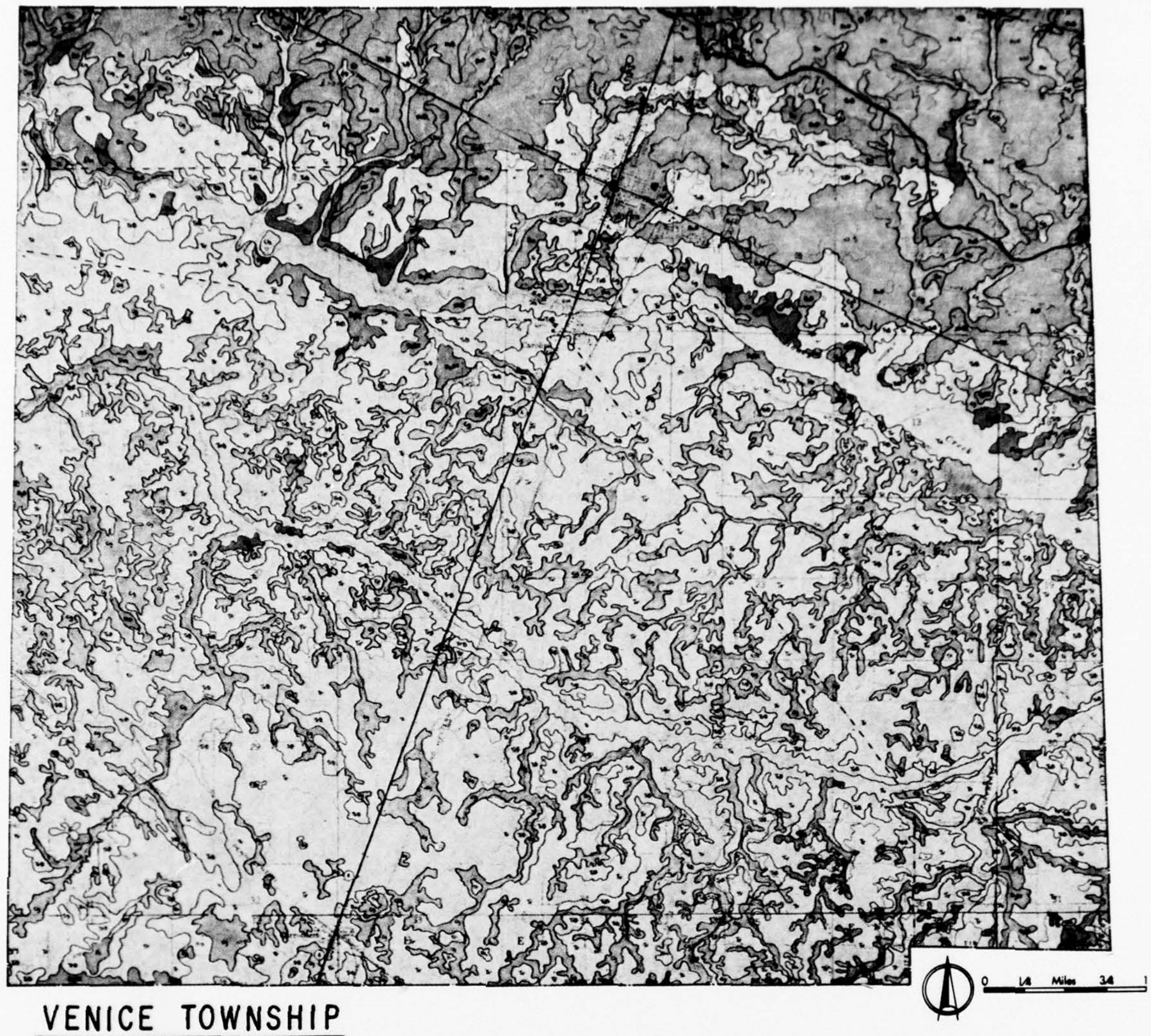
Suitability

No-till planting is suitably used on better drained soils. It can be used for any spring-planted row crop. It is most commonly used for corn and soybeans. Figures 2-2 and 2-3 show areas in Honey Creek Watershed and Venice Township, respectively, that are suitable for no-till planting. It is interesting to note where the areas of



SUITABILITY FOR NO TILLAGE CORN PRODUCTION

FIGURE 2-2



VENICE TOWNSHIP

SUITABILITY FOR NO-TILLAGE CORN PRODUCTION

SUITABLE

- YIELD EQUAL OR GREATER THAN CONVENTIONAL TILLAGE
- IF DRAINED: YIELD NEARLY EQUAL TO CONVENTIONAL TILLAGE
- IF WETNESS PREVENTS CONVENTIONAL TILLAGE: YIELD EQUAL OR GREATER THAN CONVENTIONAL TILLAGE AFTER MAY 10

UNSUITABLE

- YIELD SUBSTANTIALLY LESS THAN CONVENTIONAL TILLAGE
- MISCELLANEOUS SOILS: NOT RECOMMENDED AT THIS TIME.

FIGURE 2-3

suitability for no-till (tillage groups 1 and 2) are found with respect to local physiography shown in Fig. 1-3. The percent of cropland suitable for no-till in each physiographic region is shown in Table 2-1. Note the higher percentage of cropland in the glacial end moraine that is suitable for no-till compared to the percent suitable in the lacustrine sediments, a result of the better drainage of soils in the former.

Equipment Requirements

No-till planting requires a planter equipped with a heavy-duty fluted coulter to slice soil, a planter shoe and a press wheel. It can also be equipped with double disc soil openers that lay fertilizers in bands near seed and with herbicide applicators. Applying fertilizer and herbicide at same time as planting reduces the number of times over the field and thus costs.

Advantages

Lower fuel and labor costs are realized; greater timing flexibility is possible due to fewer operations required. Where suitable, no-till produces greater or nearly equal crop yields. Soil tilth, drainage, and moisture retention are improved.

Disadvantages

No-till requires significantly higher use of herbicides for weed control and to prevent competition by winter cover or meadow plants. Herbicide kill is unpredictable; application requires expert management. Plant residues on surface and undisturbed soil profile provide greater growth opportunities to insect pests than does conventional tillage. Fertilizer application opportunities are fewer often resulting in accumulation of nutrients on surface. Equipment modifications or purchase may be necessary. No-till in crop residues slows soil warming and drying in spring, delaying planting on poorly drained soils. Meadow or winter cover crop prior to planting should speed drying due to evapotranspiration.

Impact on Water Quality

No-till planting on chemically-killed sod can reduce soil erosion to less than five percent of that caused by conventional tillage. Because infiltration is greater, leaching of mobile nitrate may increase.

Economic Implications

Changing to no-till on soil groups 1 and 2 (see Figure 2-2) is likely

Table 2-1 - Suitability of the Physiographic Regions in Honey Creek Watershed for No-till Corn Production

Physiographic Region[2]	Suitability for No-till Planting (Percent Area of Physiographic Region)			
	Suitable For No-Till	Unsuitable for No-Till		Unclassified
	Soil Groups[1] 1 and 2	Soil Group 4 (except after: May 10)	Soil Group 3	Soil Group 5
Glacial end moraine	75.4	13.7	9.6	1.3
Lacustrine sediments	15.3	51.7	4.6	28.4
Glacial ground moraine; silty drift mantle over till, undissected	14.5	64.9	19.1	1.5
Glacial ground moraine; till mildly dissected	62.3	21.9	11.7	4.1
Entire Honey Creek Watershed	43.6	37.1	12.4	6.9

1/ Soil assignments to no-till groups by Triplett, et al (1973).
2/ Physiographic region delineation by Joseph Steiger, SCS (Upper Sandusky).

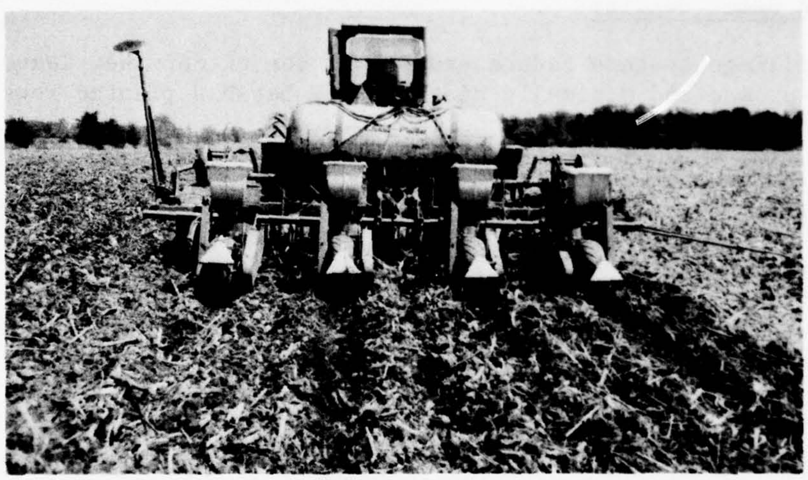
to increase (or at least maintain) net farm income obtained with conventional tillage to equal or better yields and lower fuel and manpower costs. For example, no-till practiced on Wooster soils produces $13 per acre greater profits than conventional tillage for commercial grain farms planting 50 percent corn and 50 percent soybeans (Forster, et al., 1976). Equipment changes are necessary requiring purchase of a no-till planter.

MINIMUM TILLAGE

Description

Minimum tillage refers to a broad range of tillage practices most of which have in common non-inversion tillage to retain previous crop residue and fewer field operations than conventional moldboard plow-based tillage. It applies to tillage practices that cultivate the whole field or to narrow strips where the crop is planted.

FIG. 2-4. Minimum tillage corn planting, till planting. Planter loosens soil, applies anhydrous ammonia, plants corn and applies insecticide. Herbicide is applied later. (photo: SCS)



Purpose and Rationale

Minimum tillage can be used for many reasons including reducing erosion, increasing rain infiltration, maintaining yield and controlling weeds and insects in response to local soil and climate conditions. Minimum tillage system design can vary the depth and width of soil disturbance.

Suitability

Minimum tillage should be considered for row crops on all poorly drained and very poorly drained soils where no-till is not feasible. Minimum till can include creating ridges in which seed is planted in order to accelerate soil warming (See ridge planting).

Equipment Requirements

Tillage is accomplished with a chisel plow, disc or field cultivator. Conventional planter may have to be modified.

Advantages

Minimum till requires fewer field operations therefore reduces fuel and manpower costs. Crop yields may be better than from conventional tillage particularly in dry years. Soil compaction by farm machinery is less than for conventional tillage.

Disadvantages

Weed and insect control strategies have to be reconsidered. Minimum tillage relies in part on herbicides for weed control. Herbicide application requires expert management in order to protect non-target organisms.

Impact on Water Quality

Minimum tillage systems reduce erosion to the extent they leave residues on surface and minimally disturb soil between planted rows.

RIDGE PLANTING

Description

Row crops are planted on soil ridges running with the rows that are formed during fall cultivation or are permanent.

Purpose and Rationale

Ridge planting is designed to allow earlier planting by accelerating soil drying and warming.

Suitability

Ridge planting can be used for row crops wherever soil wetness in the spring retards planting.

Equipment Requirements

Modified disc.

Advantages

Ridge planting permits earlier planting.

Disadvantages

Ridge planting has a tendency to irregular stand establishment due to seed placement difficulties. Fertilizer placement and weed control opportunities are limited.

Impact on Water Quality

Ridge planting *per se* was not designed to reduce erosion. However, when employed with contour cropping systems and furrow residue placement it is a highly effective erosion reducing practice. It may reduce overland flow and allow time for sediment deposition between ridges.

CROP ROTATIONS

Description

Crop rotation alternates two or more crops on a field in sequential growth periods. Different row crops or small grain and row crops can be scheduled. Planting grass or legume as meadow can also be one element in the rotation.

Purpose and Rationale

Crop rotation is used primarily to control pest insects by shifting insect habitat conditions and to vary the nutrient-withdrawing and soil structure influences of individual crops.

Suitability

There are no significant natural constraints to crop rotations. Economic factors play a large role in the use of crop rotation and in the crops selected for rotation.

Equipment Requirements

Greater diversity of crops requires higher investment in special harvesting equipment.

Advantages

Crop rotation provides some insect and weed control. Sod and small grain based rotations provide important winter and growing season cover.

Disadvantages

Crop rotation imposes market constraint on crops grown. Sod-based rotations reduce cash-crop acreage and require livestock for utilization of grass-legume crops.

Impact on Water Quality

Crop rotation with a grass or legume meadow component is an effective erosion control method due to the very low erosion potential of the meadow phase and its residual effects that improve infiltration in subsequent crop phases. Including winter small grain in rotation schedule provides some protection to soil from exposure to winter-spring storms.

Economic Considerations

According to a study done in Illinois in 1973, there is a large difference in net farm income between several crop rotation schedules (Lee, et al., 1974):

Crop Rotation	Net Income Per Acre
Continuous corn	$84
Corn-Corn-Soybeans	$81
Corn-Soybeans-Corn-Wheat	$69
Corn-Wheat-Meadow-Meadow-Meadow	$56
Wheat-Meadow-Meadow-Meadow	$50

Although the economic advantages of continuous corn appears obvious in this example, changing markets for crops and concern for costs associated with pest buildup and soil nutrient depletion due to continuous planting of any crop influence many farmers to rotate crops.

WINTER COVER CROP

Description

Small grain crop is planted in fall as soon as possible after harvest of previous crop. The crop is harvested, plowed under or chemically killed the following spring to prepare for next crop planting.

Purpose and Rationale

Winter cover crops are planted to protect soil from erosion during winter and spring storms.

Suitability

Winter cover crop can be used as part of many crop rotation schedules. Winter cover crops can be used where residue from previous crop is insufficient to provide erosion protection over winter.

Equipment Requirements

Conventional.

Advantages

Chemically-killed cover crop is good preparation for no-till planted row crops.

Disadvantages

Planting a winter cover crop represents an extra cost with no cash return if cover crop not harvested; depletes moisture in droughty soils.

Impact on Water Quality

Winter cover crop, when planted early enough in fall, provides excellent protection against erosion during critical winter and spring months.

CONTOUR CROPPING SYSTEMS

Description

Row crops are planted with the rows generally following the contour. Variations include graded rows in which the rows are gradually dropped to lower contours, and contour strip cropping in which alternate strips of rows and grass are planted on the contour.

Purpose and Rationale

Contour cropping is designed to impede the flow of runoff downhill by trapping it in the furrow of level or nearly level rows. If the capacity of the rows to hold and infiltrate the water is exceeded,

FIG. 2-5. a. Contour cropping. Note curved rows follow contour on this gently sloping field. (photo: Allen Co., Indiana). b. Contour strip cropping (Seneca Co., Ohio) has been used for more than 15 years on this farm. (photo: SCS)

row breakover of the runoff may occur, leading to erosion problem as successive rows give way. Graded rows can reduce row breakover tendency by allowing water to leave the field at the row end where grass filter strips could be used. Contour strip cropping depends on strips of grass planted between row crop strips to filter any row breakover, sediment-carrying runoff.

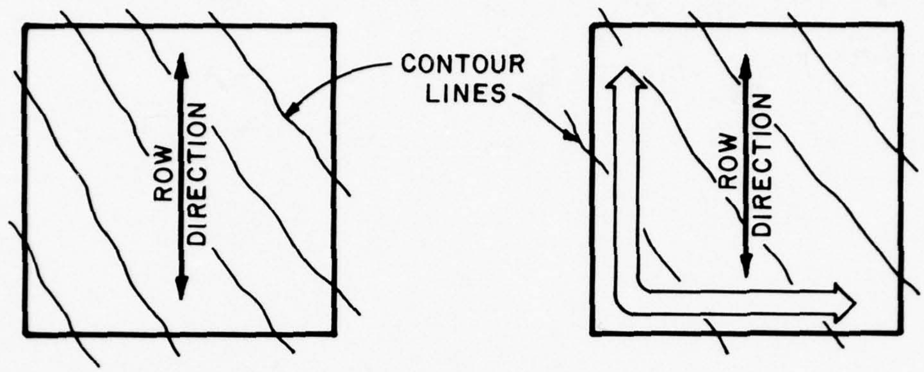
Suitability

Contour cropping systems can be used on slopes greater than 2 percent and less than 8 percent. Long slopes, particularly steep ones, require additional measures to reduce the momentum of row breakover runoff such as terraces or runoff diversions. Slopes less than 2 percent can be planted with (a) straight rows in the general direction of the contours and/or with (b) several turn rows along the two adjacent lower field edges (See Figure 2-6).

The latter variation for nearly level fields both reduces runoff momentum and traps runoff at lower edges of field.

The suitability of the terrain in Honey Creek Watershed and Venice Township for contour cropping is shown in Figures 2-7 and 2-8, respectively. Since suitability for contour cropping is based here on slope it is interesting to note where areas of suitability for contour cropping with respect to local physiography (See Figure 1-3). The steeper suitable areas are associated with the glacial end moraine.

FIG: 2-6. Adaptations to contours on fields with slope less than 2%. a. Rows in general direction of contour; b. Rows in general direction of contour with several turn rows at lower field edges.



Equipment Requirements

Usually determined by tillage system used. However, large equipment cannot operate efficiently in contoured fields.

Advantages

Contour cropping systems increase soil moisture by trapping precipitation for infiltration.

Disadvantages

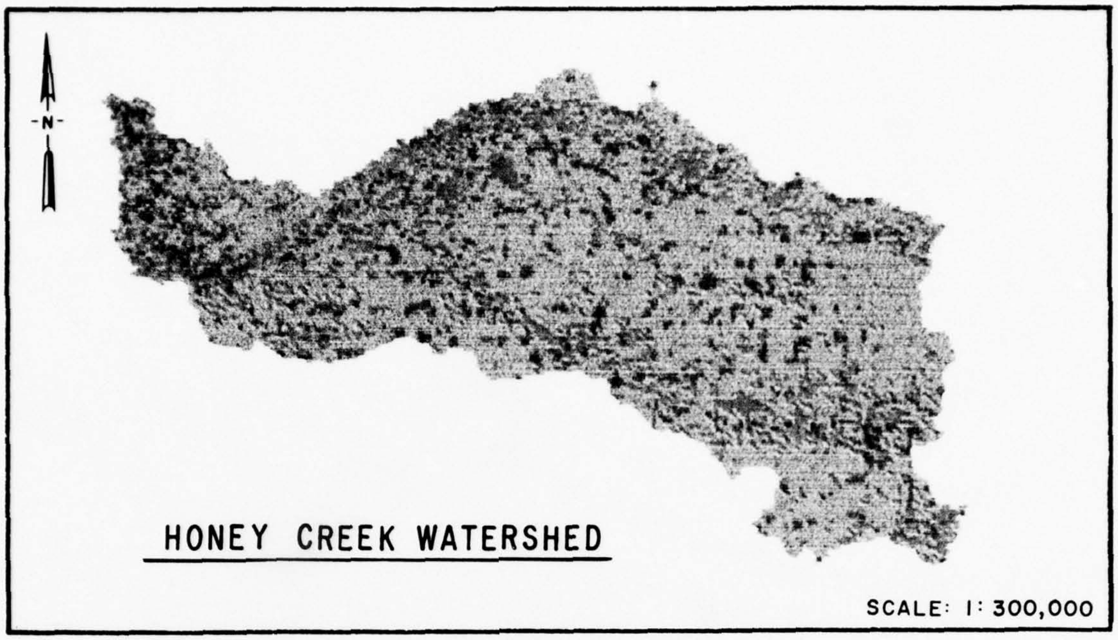
On slopes with significantly nonparallel contours, residual "point rows" remain, which are time-consuming to farm. Contour cropping systems are not suitable on very poorly drained soils and somewhat poorly drained soils since the runoff trapped in the row saturates the soil.

Impact on Water Quality

The use of contour cropping systems significantly reduces soil erosion and increases baseflow of streams by favoring the infiltration of storm water. The decrease in soil erosion over up-down slope cultivation and planting depends on soil permeability and texture, slope, slope length and whether or not graded rows, strip cropping or terraces are used.

Economic Implications

The costs of contouring are negligible in most cases. A recent study estimates the cost of contouring to be $0.75 per acre for corn, soybeans and wheat (Narayanan, et al. 1975).



URBAN LAND USE

WOODLANDS

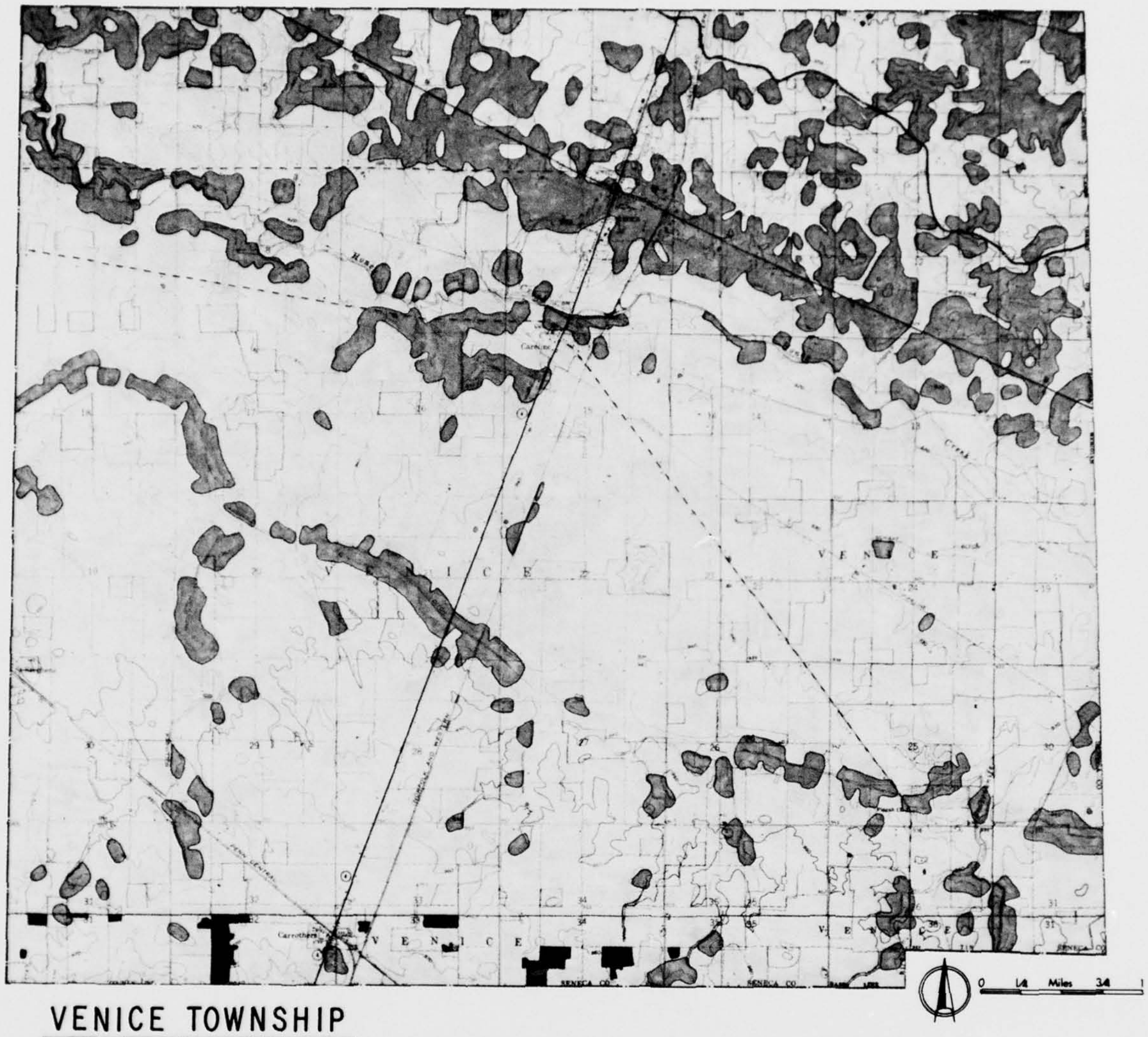
UNSUITABLE: SLOPE 0.2-2.0%

SUITABLE: SLOPE 2.1-7.0%

SUITABLE: SLOPE 7.0%

CONTOUR CROPPING SUITABILITY

FIGURE 2-7



VENICE TOWNSHIP

CONTOUR CROPPING SUITABILITY

SUITABLE

SLOPE ≥2%

UNSUITABLE

SLOPE ≤2%

FIGURE 2-8

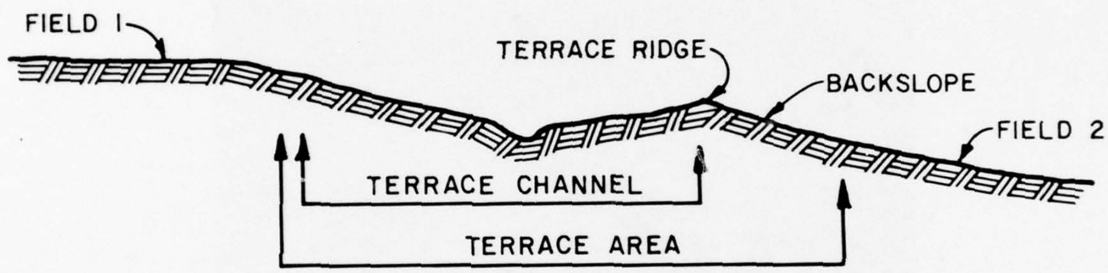
TERRACES

Description

Terraces are narrow bands of land approximately parallel to the contour part of which slopes into the hill. The terrace area consists of a channel, the terrace ridge and the back slope (See Figure 2-9). Level terraces with tile outlets to handle excess water are used in Indiana and Illinois.

The entire terrace may be cultivated and planted on the contour, but on steeper slopes the terrace backslope is planted and maintained in grass.

FIG. 2-9. Fall line cross section of terraced field.



Purpose and Rationale

Terraces are designed for sloping cropland to reduce soil erosion by shortening the slope length. Terraces interrupt downhill runoff momentum by trapping runoff from upslope row breakthrough. Trapped water is directed around the contour in the terrace channel to a swale or stream.

Suitability

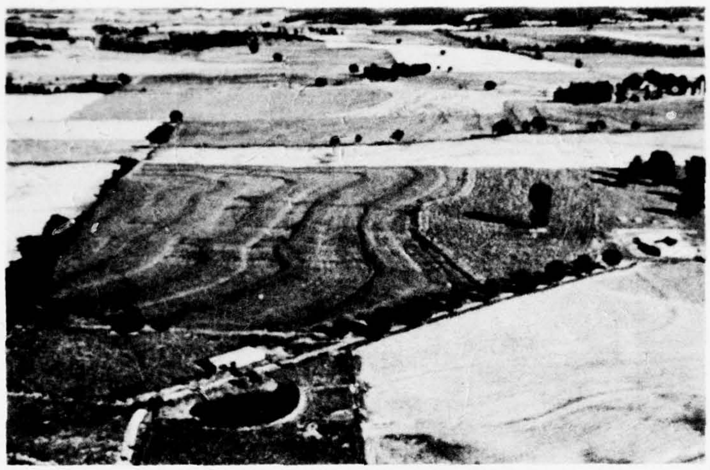
Terraces should be used wherever slope/slope length combinations that are contour cropped exceed critical values. The distance between

terraces is determined by slope/slope length, soil drainage, and rainfall. On soils with restricted drainage, terraces should have tile subsurface drain installed below channel.

Equipment Requirements

Two-way plow, motor grader for construction and maintenance.

FIG. 2-10. Terraces. Visible in foreground are two fields cultivated on terraces that carry runoff to a stable outlet. (photo: Allen Co., Indiana)



Advantages

Terraces permit more intense cropping of fields between terraces.

Disadvantages

Terraces are expensive to establish and require regular maintenance; they restrict use of large farm equipment.

Impact on Water Quality

Terraces, when used in conjunction with contour cropping systems, are very effective at reducing stream sediment by lowering runoff erosive power and by trapping sediments in the terrace channel.

Economic Implications

Installation costs for terracing are estimated to be $1.04 per acre for cropland (Narayanan, et al., 1975).

PERMANENT DIVERSIONS

Description

Permanent Diversions are constructed berms and channels that intercept runoff from upslope land and route it around cropland (See also Terraces). Berm is stabilized with vegetation.

Purpose and Rationale

By altering the natural drainage pattern with permanent runoff diversions channels, erosion-sensitive cropland is protected from upslope runoff that would normally cut through the field.

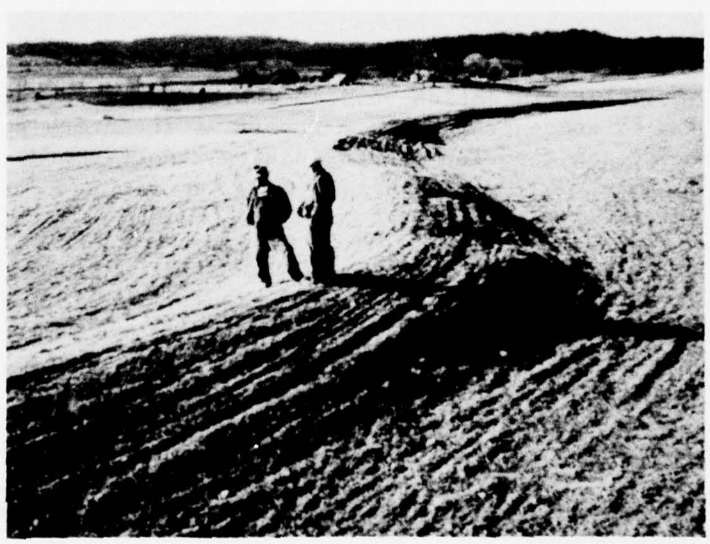
Suitability

Permanent diversions are most suitably placed in more steeply sloping areas where upslope water is concentrated by topography and would otherwise flow across erosion-sensitive land.

Equipment Requirements

Plow or blade grader; grass seeder.

FIG. 2-11. Permanent Diversions. Earth ridge and channel are seeded to perennial grasses and legumes. Diversion protects downslope field from erosion. (photo: Allen Co., Indiana)



Advantages

Permanent diversions increase time of runoff concentration thus reducing flood hazard, by increasing runoff path and decreasing slope of runoff channel.

Disadvantages

Permanent diversion on steeper slopes is subject to sloughing and erosion unless carefully stabilized and maintained. Channel may require cleanout of accumulated sediment. Improper design for capacity could cause breaching of diversion during intense storm as runoff tends to reestablish previous drainage pattern.

Impact on Water Quality

By intercepting runoff on long slopes, permanent diversions effectively reduce runoff momentum and divert runoff energy away from erodable land.

OUTLET PROTECTION

Description

Outlet protection refers to various devices and flow arrangements installed or constructed at the intersection of small drainage channels with the main stream channel. Devices can be cutoff walls installed in bank under outlet, concrete stilling basins, spillways with energy dissipators, or rock or sod chutes.

Purpose and Rationale

The purpose of outlet protection devices is to prevent streambank and bed erosion due to concentrated storm runoff as it enters stream channel. The devices function by dissipating runoff energy against a nonerodable surface.

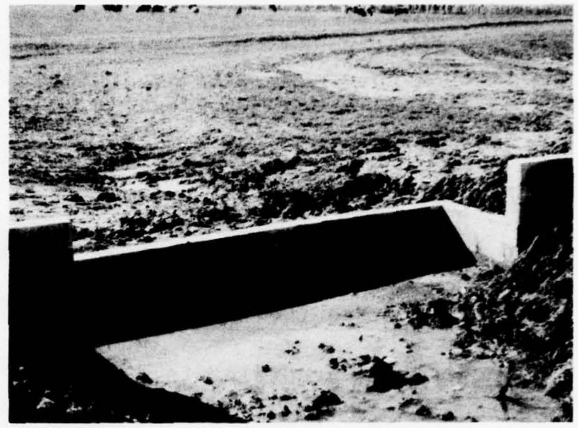
Suitability

Outlet protection devices should be used wherever there is evidence of streambank or bed erosion at drainage outlet or wherever concentrated runoff enters a stream channel at a velocity greater than that of the receiving stream.

Equipment Requirements

Varies with devices but usually requires concrete, brick, metal, or masonry work and backhoe.

FIG. 2-12. a. Rock chute outlet protection on group drainage ditch near Fostoria, Ohio, installed to prevent bank erosion from channel entering from left. b. Toe wall structure at end of grass waterway (Seneca Co., Ohio). Runoff energy is dissipated in 2-foot drop. (photos: SCS)



Advantages

Outlet protection devices protect streambed integrity and prevent gully erosion from extending into bank along outlet axis.

Disadvantages

Well designed and constructed outlet protection devices can represent a considerable expense to farmer.

Impact on Water Quality

Since outlet protection devices prevent streambed and bank erosion, their impact on water quality, will be mainly to reduce suspended solids that are less likely to be enriched with fertilizer nutrients and pesticides. Alluvial sediments along streams are often high in plant nutrients, however.

STREAMBANK PROTECTION

Description

Streambank protection is a general term referring to a family of instream devices that either reduce stream velocity or shield sensitive streambank section from erosion, or both. Structures that reduce stream velocity and thus reduce streambank scouring potential

are rock spillways, drop structures and check dams. Devices that directly protect sensitive bank reaches from erosion are aquatic vegetation plantings, rock jetties, gabions, gabion mattresses, concrete-filled nylon blankets and revetments.

Suitability

Streambank protection measures should be installed whenever a change in land cover could cause increased runoff or where increased runoff or stream channel realignment is presently causing streambank erosion.

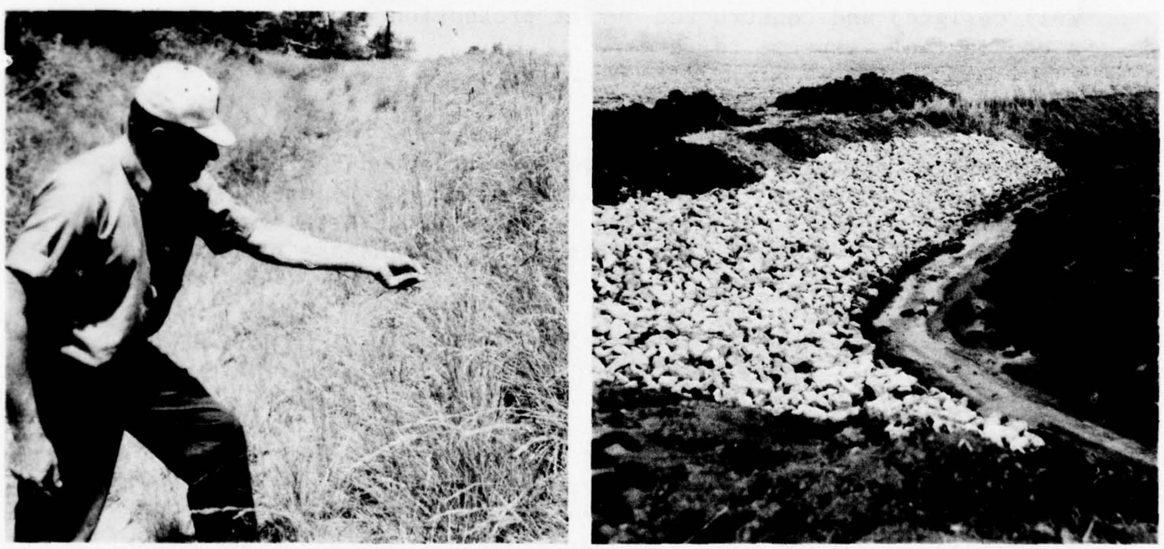
Disadvantages

Such measures are usually very expensive to install.

Equipment Requirements

Specialized according to device.

FIG. 2-13. a. Vegetative cover as means to protect stream bank (Seneca, Co., Ohio). SWCD Executive Secretary is shown inspecting three year old Kentucky 31 Fescue seeding on group ditch. b. Rock protection for stream bank. Rip-rap is placed on curve of group ditch (Seneca Co., Ohio) to dissipate energy of storm water as it changes direction. (photo: SCS)



Impact on Water Quality

See outlet protection.

WINDBREAKS

Description

Windbreaks are rows of trees or bushes planted at field edge or narrow strips of winter cover crop left standing during spring crop planting.

Purpose and Rationale

Windbreaks of trees are placed at the windward edge of fields to reduce the erosion of soil by high velocity winds. They reduce wind erosion by deflecting wind direction upward and by reducing wind energy passing through tree branches thereby creating a pocket of slower moving air on the leeward side. Windbreaks also trap some windstorm particles. The placement of the trees is guided by the direction of the prevailing winter and spring winds when soil is vulnerable.

Suitability

Windbreaks are most effectively used to protect sandy, sandy loam, and muck soils from wind erosion.

Equipment Requirements

Tree planting machinery.

Advantages

Windbreaks protect seedlings from abrasion damage by windblown particles and from wind drying damage. They reduce heat loss from heated structures, humans, and livestock. They provide habitat for birds and other wildlife and are a visual amenity in flat landscapes.

Disadvantages

Initial tree-planting costs are substantial.

Impact on Water Quality

The loss of soil from sandy-textured cropland soils by wind action can be much higher than that caused by water erosion. Soil losses as high as 130 tons per acre during a single storm have been observed in Ohio.

FIG. 2-14. Windbreak. Young farmstead wind break (Seneca Co., Ohio). Two rows of 4 to 5 foot tall balled Norway spruce were planted 10 feet apart in rows and 12 feet apart between the rows. *(photo: SCS)*

The finer particles carried off contain a higher proportion of adsorbed nutrients and pesticides than the coarser material left behind. Deposit of a portion of this load in large water bodies can significantly add to suspended solids carried there by water. Windbreaks are similar to permanent diversions and sediment basins in that they divert winds from susceptible fields and trap some already airborne soil particles.

AGRICULTURAL PRACTICES THAT TRAP ERODED SOIL

GRASSED OUTLETS

Description

Grassed outlets or waterways are natural (or man made) swales in cropland that have been removed from use for row crops and planted with an erosion-resistant grass.

Purpose and Rationale

Grass outlets are installed to protect soil in swales from erosion. They serve to accept, impede, and filter sediment-laden runoff from contour rows, terraces, and diversions or to accept storm water runoff from adjacent fields. When storm runoff from fields goes directly to a drainage ditch, a grassed buffer strip parallel to the ditch slows and filters runoff (See Figure 2-15b).

Suitability

Grassed waterways should be installed wherever natural swales in fields show signs of gully erosion.

Equipment Requirements

Scraper on tractor or blade grader, if gullies must be filled; grass-planting drills, for certain grasses.

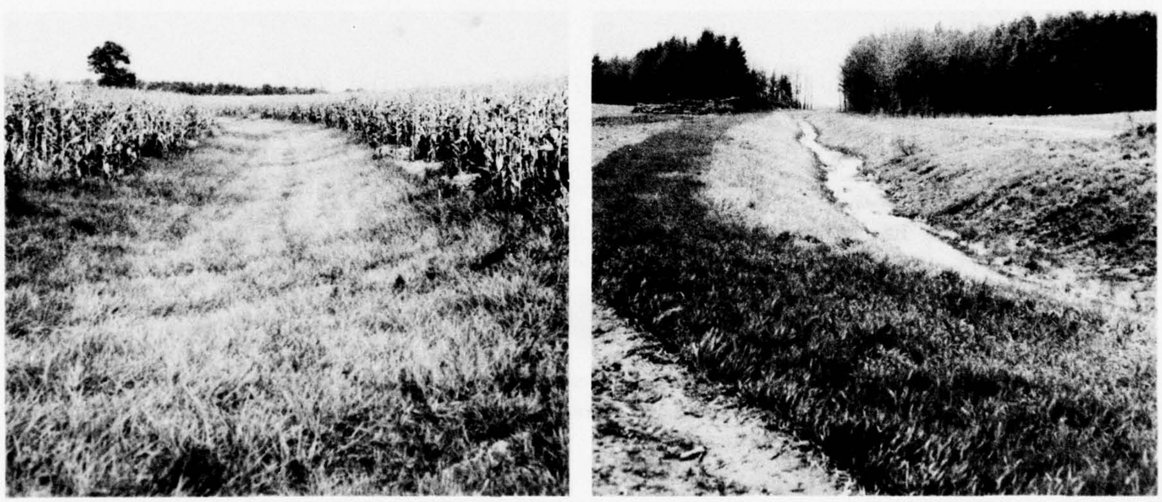
Advantages

Grassed waterways can be used for pasture or for hay or seed production. They reduce wear and tear on farm machinery crossing gullies.

Disadvantages

Grassed waterways remove land from high-income crop production. Timing of initial grading and planting are critical to avoid severe erosion. The survival of an established grass waterway may be jeopardized by use of grass-killing herbicides for weed control. Particularly incompatible with grassed waterways is no-till planting that uses chemically-killed sod as a seedbed.

FIG. 2-15. a. Grassed waterway (Seneca Co., Ohio) is shown. A tile main is installed along right side of the waterway. b. Grass filter strip at field edge. Kentucky 31 Fescue seeded on 10-foot wide sod berm. Ditch banks are also seeded. (photos: SCS)



Impact on Water Quality

Well-designed and maintained grassed waterways can significantly reduce sediments carried to perennial streams by three mechanisms: They protect vulnerable swales from erosion, absorb runoff energy and filter sediment delivered from cropland.

IN-FIELD BERM WITH CONTROLLED-RELEASE PARALLEL TILE OUTLET

Description

Berm is constructed and maintained on contour in lower field edge at foot of water-gathering slope. Restricted outlet to the drain on uphill side of berm slowly releases trapped runoff.

Purpose and Rationale

In-field berm with controlled release tile outlet is designed to provide sedimentation opportunities before storm water reaches waterway by detaining sediment-laden runoff.

Suitability

In-field berms with controlled release tile outlet can be used near downhill field edge of water-gathering slopes where contour cropping systems are not appropriate.

Equipment Requirements

Tractor with grader blade and tile-laying machinery.

Advantages

In-field berms trap eroded soil on field preserving soil resource and do not take land from production since berms are farmed.

Disadvantages

This measure has a moderately high design requirement and initial costs. It is not applicable to water spreading slopes.

Impact on Water Quality

By providing temporary storage for sediment-laden runoff, an opportunity is created by settling of suspended solids in the field before runoff enters surface waters.

SEDIMENT BASINS

Description

Sediment basins are natural or excavated wide depressions in swale or stream paths with controlled water release at outlet.

FIG. 2-16. Sediment basin. A dam was constructed across watercourse to trap and contain sediment from eroding sites. (photo: Allen Co., Indiana)

Purpose and Rationale

Sediment basins are designed to hold the runoff from a storm and to release it at a rate over the specified period. The basin provides sedimentation opportunities to larger soil particles thus preventing them from being carried downstream.

Suitability

Sediment basins are most effective in small drainage areas having soils with predominantly larger particle sizes.

Advantages

See impact on water quality.

Disadvantages

Sediment basins may require removal of cropland from production. They require periodic sediment removal. Colloidal particles derived from clay soil are not efficiently removed in sediment basins. In addition, initial costs as well as maintenance costs are high.

Impact on Water Quality

Sediment basins represent the last opportunity to intercept eroded soil particles before storm runoff enters streams and rivers. Although they may trap a significant proportion of eroded soil in runoff, a disproportionate amount of adsorbed nutrients and pesticides on the greater surface area provided by finely divided sediment (size 10) escapes entrapment in the sediment basin.

MANAGEMENT OF LIVESTOCK WASTES

Feedlot and Poultry

Manure from confined livestock feeding operations represents a potent source of water pollution if not correctly managed. There are many approaches to correct manure management that depend upon the kind of livestock kept, number of head and the opportunity for utilizing the nutrient value of the manure. The system components are the livestock housing facility, manure collection, storage, transport and waste use. In order to prevent leaching of soluble manure substances to ground and surface water, animals should be housed indoors or out, and on or above an impervious base. Manure should be removed frequently from the pen area for short-term storage or for direct application to the land. Storage facilities should likewise have an impervious base and be covered if possible. Outdoor pens and uncovered manure storage areas should be trenched on periphery to intercept runoff from the manure. The runoff should be collected and treated or applied directly to the land. Runoff from pens should never be allowed to discharge directly to channels or streams.

Pastured Animals

Dairy cattle, sheep and swine herds should be fenced from streams and other drainage features to prevent disturbance of bank vegetation, creation of turbidity, and direct contamination of stream water with manure.

FIG. 2-17. a. Storage of livestock wastes. A solid storage animal waste structue (photo: SCS). b. Holding pond for livestock liquid wastes and runoff from feed lots. (photo: Allen Co., Indiana)

MEASURES TO REDUCE CHEMICAL INPUTS TO CROPLAND

CHEMICAL FERTILIZER MANAGEMENT

By altering the amount of fertilizer used, the timing and mode of application, the form used, and crops grown, a decrease in the amounts of fertilizer nutrients lost to surface waters can be reduced.

Fertilizer Application Rate

On fields where chemical fertilizers have been applied at rates above maintenance levels for many years, it is likely that the phosphate has accumulated in the soil. Soil tests will reveal the actual amount of phosphate available for plant growth. In Ohio, it is recommended that if soil phosphate levels test above 30 lbs. (as plant available P) per acre, only maintenance fertilizer application rates (that which crop removes) be applied for corn and soybeans and buildup fertilizer application rates for small grains and forage legumes. If soil levels test above 60 lbs. phosphate (P) per acre, maintenance fertilizer application rates for all crops are sufficient. See Table 2-2 for actual maintenance and buildup fertilizer application rates recommended for these crops. Reduction of phosphate fertilizer costs thus depends on soil phosphate levels and crop planted. However, strict maintenance application may impair yields in years with abnormal growing season weather.

Timing of Application

Optimum timing of application of N fertilizers with respect to crop need can significantly reduce N loss by leaching thus effecting a cash saving since less need be applied for a given yield goal. Nitrate application in fall is subject to leaching through winter months and should be avoided. Application on snow should be avoided due to possible nutrient loss in snowmelt runoff. Spring application of fertilizer may crowd an already busy schedule and rainfall may not be sufficient to move fertilizer into root zone. Post-planting application may deprive young plants of needed nutrients leading to stunted root development.

Mode and Form of Application

Incorporation of fertilizers into soil directly or soon after application by turning over soil reduces possibility that storm water will dissolve and carry fertilizer components away in runoff. When plowing-in is not possible due to tillage system used, fertilizer can be applied as a band in soil near seed, or applied to surface in liquid form. If applied to soil surface, application should wait until after the high runoff period has passed. Alternatives to conventional fertilizers include grass legume crops which fix nitrogen in the soil for use by subsequent crops, animal manure, and controlled release fertilizer. The use of animal manure as fertilizers recycles to the land a potential and direct source of water pollution. Since nutrients are released from manures by temperature-dependent biological processes, nutrient availability from manures corresponds generally to plant needs and the leaching potential is minimized. However it is difficult to know the exact nutrient content of animal manures. Manures usually do not have the appropriate nutrient ratios for crops, particularly nitrogen deficiencies in older manure. Application of manure is more difficult and slower than for chemical fertilizer due to its bulk. Slow release chemical fertilizers are not yet commercially competitive with conventional chemical fertilizers.

PESTICIDES

Nearly all insecticides and most herbicides are synthetic organic compounds. They are designed to kill, often affecting nontarget organisms in delayed and indirect ways. It is important to realize that pesticides kill because living systems are not equipped to deal with these substances since synthetic pesticides were not part of the creation and evolution of life. Thus, when it is necessary to use these substances to control insect pests and weeds, they must be applied in the lowest dose possible consistent with yield expectations and be applied with great caution to protect people and other

Table 2-2 - Phosphate Fertilizer Application Guide. Recommended fertilizing rates for phosphate, shown below, are based on crop grown, existing soil phosphate level, and yield expectations. For much cropland in northern Ohio, it is likely that phosphate is being applied in excess of recommended amounts. (Data from CES Bulletins 472 and 561, OSU.)

Available Soil Phosphate (lbs./acre as P)	Recommended Application Rate of Phosphate (lbs./acre as P)			
	Corn	Soybeans	Wheat	Forage Legume
61.2-75.7	Maintenance rate only:		Maintenance rate only:	
	13.2	11.0	13.2	35.2
29.9-60.7				
	19.8	17.6	17.6-28.6	37.4-46.2
29.9	Buildup rate required*		Buildup rate required**	
	22.0	19.8	35.2	50.6
Phosphate removed in crop for intermediate yield goal	18.9	17.6	14.1	34.3

*Fertilizer rate recommendations based on intermediate yield goals: Corn - 120 bu./acre; soybeans - 50 bu./acre; wheat - 50 bu./acre; forage legume 6T/acre.

**Buildup rate includes maintenance rate.

non-target organisms. Pesticides used should have a short environmental persistence time, not degrade to stable toxic substances, have low toxicities to water organisms and have an affinity for soil so that with an effective erosion control program, the amount of pesticide carried off the field in storm runoff is reduced.

LOCAL AGENCIES PROVIDING ASSISTANCE TO THE AGRICULTURAL COMMUNITY IN HONEY CREEK WATERSHED.

Federal, State and local Governments are organized to provide technical and financial assistance to farmers requesting and in need of it. The agencies serving the agricultural community in the Honey Creek watershed and the services they offer are:

Soil and Water Conservation District	Coordination of Technical, financial assistance.
Ohio Agriculture and Research Development Centers	Research on farming methods.
Cooperative Extension Service	Education services to the community on all aspects of farm life.
Farmers Home Administration	Financial Assistance
Soil Conservation Service	Technical Assistance.
Agricultural Stabilization and Conservation Service	Financial Assistance.
PCA and Federal Land Bank	Financial Institutions.

Farmers in the Honey Creek watershed are urged to contact the local Soil and Water Conservation District office for more detailed information on the practices that are described above and for guidance in actually using those practices that are suitable to the land.

Soil and Water Conservation Districts

Soil and Water Conservation districts in Ohio are established by the State Department of Natural Resources under the Division of Soil and Water Districts on a county basis. One general role is to assist the farming community with conservation practices for its land. SWCD offices work very closely with a county SCS staff and provide a liaison and referal service to farmers for all Federal and State educational, technical, and financial agricultural assistance programs.

Farmers in the Honey Creek Watershed interested in the range of services available through their conservation districts should contact the appropriate county office:

COUNTY	ADDRESS	PHONE
Seneca	155 E. Perry St. Tiffin, OH 44883	(419) 447-7891
Crawford	Room 2, P.O. Bldg. Popular and Warren Sts. Bucyrus, OH 44820	(419) 562-2203
Huron	180 Milan Ave. Box 546 Norwalk, OH 44857	(419) 668-5143
Wyandot	First Citizens Nat. Bank Bldg., Box 319 100-1/2 N. Sandusky Ave. Upper Sandusky, OH 43351	(419) 294-3223

Cooperative Extension Service

The Cooperative Extension Service provides an educational service to farmers and rural families on all aspects of farm operations. Through its programs, the Cooperative Extension Service emphasizes the economic improvement of rural areas by helping people understand and use scientific information relating to agriculture, home economics and natural resources. It maintains its strong ties to research through the Director who is also Dean of Agriculture and Home Economics at OSU and Director of the Ohio Agricultural Research and Development Center. The Extension reaches farmers through newsletters, newspapers, farm magazines, radio and television. It conducts courses, workshops, meetings and seminars on a range of topics. The Extension operates a soil testing laboratory at the Ohio State University as a service to farmers who want to gear their fertilizer rates to plant and soil needs. The Extension Service publishes bulletins, often together with other technical assistance agencies, on many topics of interest to farmers based on recent agricultural research by the College of Agriculture and Home Economics at the University, the Ohio Agricultural Research and Development Center, and the U. S. Department of Agriculture. The Ohio Erosion Control and Sediment Pollution Abatement Guide (Bull. 594) and the 1976-77 Agronomy Guide (Bull. 472) are two bulletins that stress the importance of soil and water conservation methods and sound farm management. The Cooperative Extension Service has 10 area offices in Ohio and an office in every county in the State. Each area office offers

advice in a different range of specialties depending upon the needs of the area. Each county office is staffed with an agricultural agent, a home economics specialist and, in all but 13 counties, a 4-H Club worker. Anyone in the Honey Creek watershed interested in information about the programs, publications and range of services of the Extension should contact the local county office.

COUNTY	ADDRESS	PHONE
Crawford	Court House Bucyrus, OH 44820	(419) 562-8731
Huron	180 Milan Ave. Norwalk, OH 44857	(419) 668-8219
Seneca	155-1/2 E. Perry St. Tiffin, OH 44883	(419) 447-9722
Wyandot	Court House Upper Sandusky, OH	(419) 294-4931

Soil Conservation Service (U. S. Department of Agriculture).

County offices of the SCS encourage and help landowners and farm operators to develop conservation plans for rural properties. Conservation plans are drawn up upon the request of the farmer in order to protect soil resources from erosion and to put each piece of land to best use according to its capabilities to respond to management. In addition to land use decisions, the plan records agreed upon improvements such as installation of tile drains, grass waterways, contour cropping, terraces, or brush and weed control. The last part of the plan schedules the changes needed and provides technical details for any construction called for in the plan. SCS also publishes and distributes short articles on a range of soil conservation measures. Technical assistance in designing and the application of the selected practices is also provided. Any farmer in the Honey Creek Watershed who wishes to take advantage of the conservation planning service should contact the appropriate SCS office, listed below:

COUNTY	ADDRESS	PHONE
Seneca	155-1/2 E. Perry Ave. Tiffin, OH 44883	(419) 447-9722
Crawford	Post Office Bldg., Popular and Warren Sts. Bucyrus, OH	(419) 562-2203

Huron	180 Milan Ave. Norwalk, OH	(419) 668-5143
Wyandot	First Citizens National Bank Bldg. Box 319 100-1/2 N. Sandusky Ave. Upper Sandusky, OH 43351	(419) 294-3223

Agricultural Stabilization and Conservation Service

This agency of the U. S. Department of Agriculture provides financial assistance to farmers in the form of cost-sharing for a range of soil and water protection measures and structures. Practices cost-shared upon vary from year to year and county to county. County Committees choose for emphasis in their county certain practices from a State and national list. Some of the projects eligible for cost-sharing are listed below.

Establishing permanent vegetation on critical areas.

Improving permanent vegetation on critical areas.

Planting trees.

Improving forest stands.

Strip cropping.

Constructing terraces and diversions.

Control structures for sediment retention, erosion, and runoff.

Open ditch ground waterways.

Reduced tillage.

Application of liming material.

Construction of livestock watering facilities.

Growing winter cover crop.

Construction of animal waste confinement structures.

Project applications are accepted from farmers directly or as part of a farm conservation plan. In either case the SCS provides a technical review of the proposal for soundness. ASCS assigns it a

priority ranking for funding. For more details on qualifying programs and levels of financial support contact the local Agricultural Stabilization and Conservation Service.

DEMONSTRATION PROJECTS IN THE REGION

The Ohio Agricultural Research and Development Center (OARDC) has 13 branch laboratories and field research units throughout the State. It has close ties through projects and professional staff with various Departments in the College of Agriculture and Home Economics at OSU and county extension offices. The Center encourages or promotes visits by farmers to their various units to see research demonstrations of new farm technologies and to discuss the results of agricultural research into better ways to manage farm operations with the research staff members. Each branch holds Field Days throughout the year on selected topics in farm management. Persons in Honey Creek interested in seeing first hand some of the practices discussed above should contact nearby branches, listed below, and watch local newspapers and listen to TV and radio for announcements of Field Days to be held at OARDC branches.

Northwestern Branch	Hoytville (Wood Co.)
Green Springs Crop Research Unit	Green Springs (Sandusky Co.)
Muck Crops Branch	Willard (Huron Co.)
North Central Branch	Vickery (Erie Co.)
Wooster, Center Headquarters	Wooster (Wayne Co.)

Photography Credits for Chapter 2

USDA-Soil Conservation Service	Figs. 2-4, 2-5b, 2-12, 2-13, 2-14, 2-15, 2-17a
Allen County Indiana Soil and Water Conservation District "Sediment in the Maumee Basin."	Figs. 2-5a, 2-10, 2-11, 2-16, 2-17b
OSU/OARDC. Proceedings of a Symposium on No-Tillage Systems, February 21-22, 1972 (L.L. Harold: "Soil erosion by water as affected by reduced tillage systems").	Fig. 2-1

CHAPTER 3

AGRICULTURAL ACTIVITIES IN VENICE TOWNSHIP AND OPPORTUNITIES FOR IMPROVED FARM MANAGEMENT

Introduction

The purpose of this chapter is to suggest some appropriate farm management practices for Venice Township that are designed to reduce the loads of sediment, nutrients and agricultural chemicals ultimately carried to Lake Erie by Honey Creek. The recommendations are based on an analysis of the hydrologic and water quality responses of the Honey Creek watershed to storm and nonstorm periods and to seasonal variations in land cover, as presented in Chapter 1. The practices recommended are described in Chapter 2 and are directed to those areas of the township where they appear to be applicable. For several of these practices it is possible to actually map areas where opportunities for improved farm management exist.

In Chapter 1, the various sources of water pollution in the Honey Creek watershed were evaluated to determine the contribution of each to the tons of solids and phosphate leaving the watershed annually. Based on land use and water quality information it was concluded that agricultural land use is responsible for most of the observed sediment and phosphate loads passing Melmore in Honey Creek.

Furthermore, when climatic, streamflow and water quality data were examined on a day-to-day basis, it was possible to determine when during the year parts of the annual load flowed past Melmore to the Sandusky River and eventually to Lake Erie.

In Chapter 1 the following observations were made:

1. More than 90 percent of suspended solids load and 75 percent of total phosphate load left the watershed during storm events.

2. Winter and spring storms are particularly damaging to soil resources due to the bare soil and high water table.

3. Summer storms, while often intense, fall on soil with a higher capacity to accept water and with a partial or full vegetative cover to reduce rainfall impact.

4. Small but biologically active amounts of soluble phosphate are available at soil surface during winter months for removal by storm and snowmelt runoff.

5. Snowmelt data suggest very strongly that most suspended solids come from land runoff and not from streambank erosion.

6. Cropland contributes more phosphate to Honey Creek than that attributable to the residential and livestock waste disposal, urban runoff and natural background combined.

Directly from these findings come recommendations for management practices:

1. Protect soil from raindrop impact and sheet erosion during winter and spring storms when soil is without a growing crop.

Conservation tillage practices - no-till and minimum tillage - are those most effective in reducing raindrop impact by planting in chemically killed winter cover crop without cultivation or by leaving prior crop residues on soil surface during winter-spring months. Meadow based crop rotations intrinsically provide winter cover of soil during the meadow phases.

2. Protect soil from sheet erosion during summer storms when growing crops provide some protection against raindrop impact.

Contour cropping, contour strip cropping and terracing are measures designed to prevent sheet erosion by slowing runoff and by shortening slope length over which runoff increases its erosive power.

3. Trap eroded soil before it enters stream.

Grassed waterways, on-field berms and sediment basins are measures to trap soil particles after erosion has occurred.

4. Reduce presence of soluble nutrients at soil surface.

Modification of fertilizer timing, rates and application made may be appropriate.

5. Reduce nutrient inputs to surface water directly from livestock wastes and indirectly by leaching of excess nutrients applied as fertilizer.

Practices which accomplish these goals can be used in Venice Township to reduce loads of pollutants to the water of Honey Creek. In the section that follows, existing farm practices in Venice Township are described. Opportunities for altering farm management in the township are then identified.

Farming Practices in Venice Township* and Opportunities for Improved Farm Management for Water Quality

Venice Township is located in Seneca County in the north-central portion of the Honey Creek watershed (See Figure 1-2). The mainstream of the creek transects the township from east to west roughly separating the end moraine in the north from the ground moraine to the south.

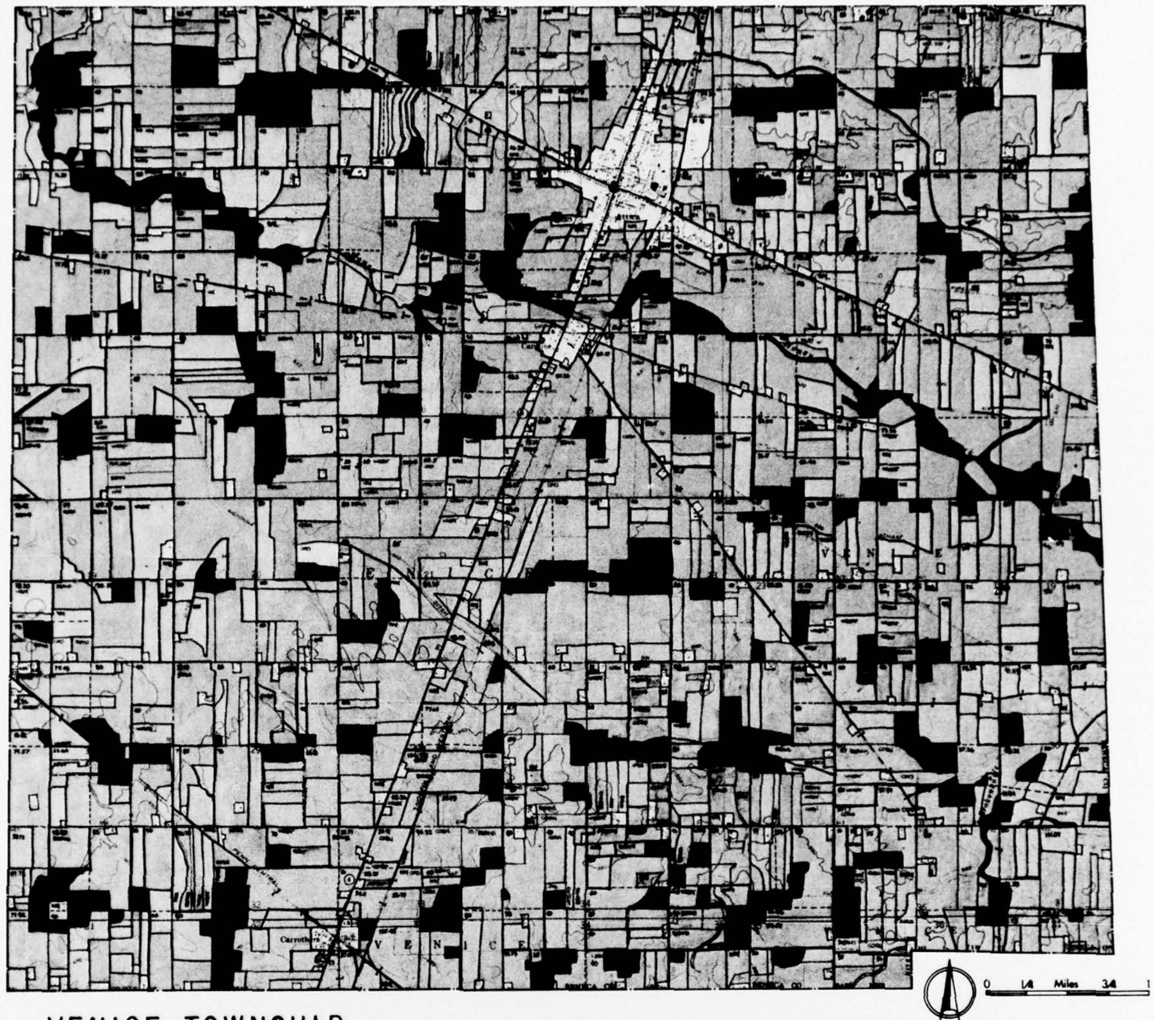
The township is predominantly rural with the village of Attica found just to the north of the creek. Figure 3-1 shows the land use of Venice Township with row and field crops, pasture, woodland and urban uses indicated. The land use map was prepared by interpretation of high altitude infrared photographs taken by NASA on 4 June 1976.

In 1976, the crops grown in Venice Township were mainly corn, soybeans, wheat and hay. Table 3-1 gives the percent of land devoted to each crop and compares this to Seneca County crop data. Venice Township is typical for Seneca County in the crops grown.

Table 3-1 - Comparison of Crops Grown in Venice Township and Seneca Co.

Row Crops	Field Crops	Percent of Cropland Area: Venice Township	Percent of Cropland Area: Seneca County
		%	%
Corn		32	27
Soybeans		37	39
	Wheat	19	22
	Oats	6	6
	Hay	3	7

*Generalizations on agricultural practices in Venice Township are based on results from the Venice Township Agricultural Practices Survey, conducted by Anita Russelmann (Resource Management Associates) and Gary Becker (OSU) as interpreted by Becker and Forster (1976) and RMA; and on responses to the survey given by Gene F. Baltes (SCS) and William Smith (SWCD) of Seneca County.



VENICE TOWNSHIP

LAND USE

USE INTENSITY: MOST → LEAST

- AGRICULTURE: ROW CROPS (CORN, SOYBEAN, OTHER)
- AGRICULTURE: FIELD CROPS (WHEAT, HAY, CORN, ALFALFA, OTHER)
- AGRICULTURE: MEADOW
- WOODLANDS
- VILLAGE OR RURAL RESIDENTIAL

FIGURE 3-1

Tillage Systems

Nearly all the farms in Venice Township use the standard moldboard plow to some degree and do as much of their plowing in the fall as possible. If the fall is wet, plowing is delayed until the spring. Less than half of the farms use the chisel plow either as the main plow or for special soil or crop sequence situations. It is estimated that anywhere from 35-50 percent of the township area is chisel plowed in the fall, with corn and soybean residues returned to the field. This practice can be classified as reduced tillage. There is ample opportunity to convert from moldboard to chisel plow. This transition is now underway as older moldboard plows are replaced with chisel plows.

No-till planting is not used in the township although approximately 20 percent of the soils are suitable for no-till if drainage improvements are provided. Furthermore, 60 percent of the cropland in Venice Township could be planted by the no-till technique with a yield advantage if wetness prevents fall and spring plowing beyond May 10th (See Figure 2-3). In Figure 2-3, suitability for no-till is expressed as an opportunity for improved farm management in areas not using it. Farmers in Venice Township with fields that are indicated as showing opportunity for no-till in Figure 2-3 are urged to consider it, particularly if they are a year or so away from investing in new planting equipment.

Ridge planting is not used in Venice Township.

Crop Rotations

Three typical rotations found in the township are:

1. corn - corn - beans - wheat - hay

2. corn - beans - corn - beans - beans

3. corn - beans - wheat - oats - hay

Rotations are not rigidly followed and many farms are now growing more row crops than they did three years ago. Rotation, particularly with a meadow phase (hay), was identified in Chapter 2 as an erosion-reducing method due to its positive effects on soil permeability and the protection the wheat and meadow phases provide against erosion by winter and spring storms. There is limited opportunity to further reduce erosion by crop rotation in Venice Township, although a meadow phase could be included in the rotation schedules of many farms if the farm has some cows. The meadow phase could also be used as a plow down to improve soil tilth.

Winter Cover

When wheat is included in a rotation schedule, it is planted in late September or early October after the Hessian fly date has passed. Winter wheat is several inches high and the young plants have splayed leaves in Venice Township before cold weather stops growth. This cover provides minimal protection against erosion during winter and spring storms.

Another practice in Venice Township is interplanting clover (in February) or alfalfa (after frost danger) in winter wheat. These forage crops germinate but, due to the earlier start of the wheat, grow slowly until the wheat is harvested in July. Then their growth takes off and by the time the cold weather stops growth, this cover of clover or alfalfa provides protection against erosion during winter spring storms. These practices reduce erosion, improve soil tilth and are an income source.

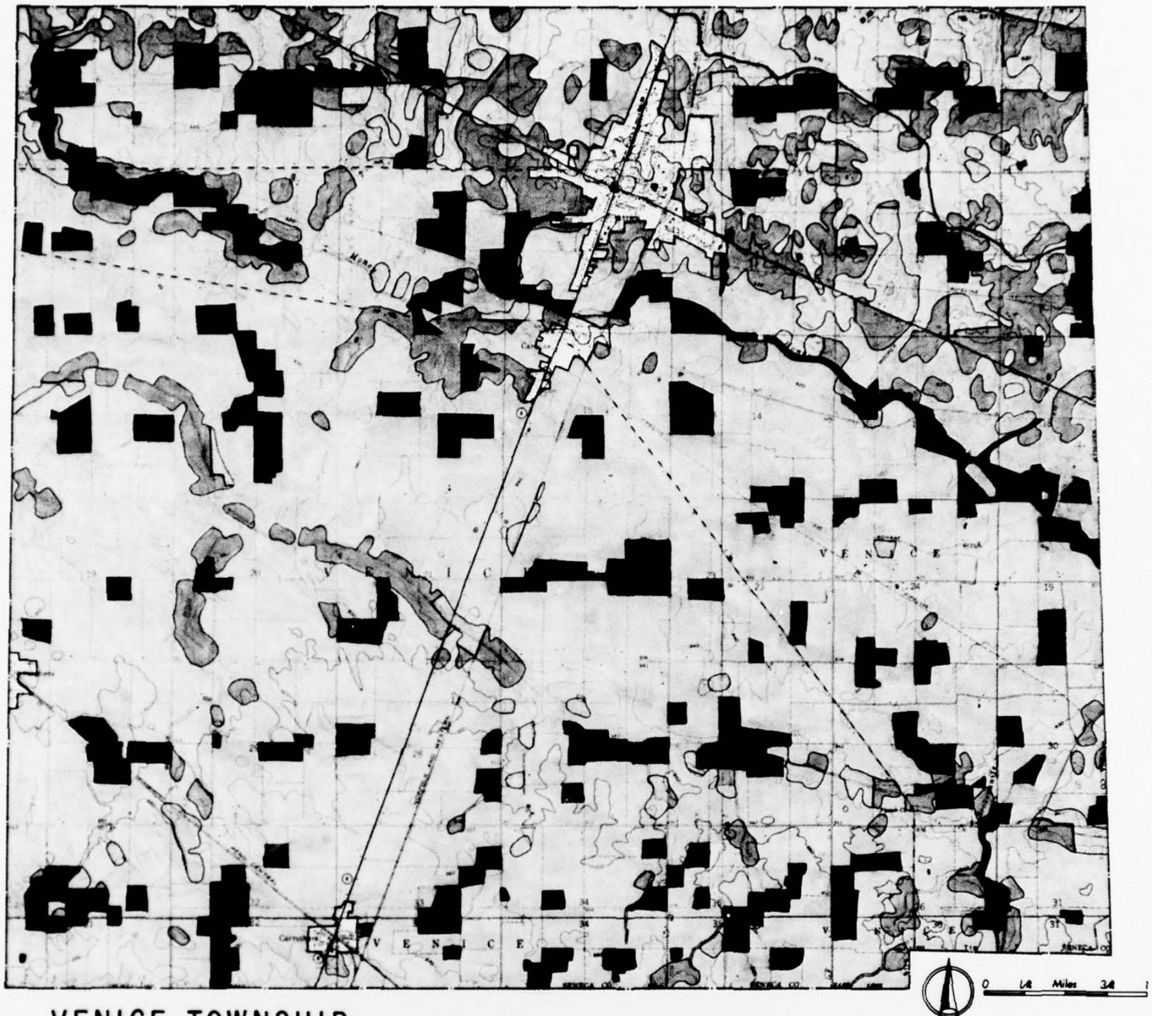
Contour Cropping

Very little of Venice Township is suitable for contour cropping (See Figure 2-8) due to its predominantly flat character. In the slightly rolling end moraine areas in the northern quarter of the township, east and west of Attica, there are several areas where the slope is suitable for contour cropping and some farmers have applied this effective erosion control practice to their land, either by planting with the contour or by planting straight rows in the field direction that more closely follows the contours (See Figure 2-6). These fields, as well as those fields where opportunity for contour cropping exists, are shown in Figure 3-2.

Terraces and permanent diversions are not used in Venice Township. Suitability of fields in Venice Township for terraces is limited due to the low slope-slope length ratio of most fields in the township. However, the limit of contour effectiveness ranges from 400 to 200 feet on slopes 2 - 8 percent which indicates the appropriateness of using terraces on larger fields with slopes above 2 percent (See Figure 3-2).

Outlet Protection

Nearly all new channel improvements and tile drains in Venice Township are constructed with some form of outlet protection to prevent bank erosion. Installation of more of these devices will occur as individual and group drainage improvements are made.



VENICE TOWNSHIP

OPPORTUNITY FOR CONTOUR CROPPING

OPPORTUNITY

- CONTOUR CROPPING

BEST PRACTICE ALREADY IN USE

- CONTOUR CROPPING SLOPE ≥2%
- CONVENTIONAL UP AND DOWN HILL CROPPING SLOPE ≥2%
- VILLAGE
- WOODLAND

FIGURE 3-2

Sediment Trapping

About half of the farms in Venice Township have at least one grassed waterway. A small number of farmers use sod filter strips at field edge to protect adjacent drainage channels or streams. Most farmers cultivate right up to the edge of channels and streams. Thus there is ample opportunity to improve water quality by installation of both grassed waterways and planting of sod filter strips.

Several farms in Venice Township use sediment basins to trap soil eroded from fields. Their use is limited due to their inefficiency in trapping the fine soils that predominate in the township. Infield berms with controlled release parallel tile outlets are not used in Venice Township. This recent innovation from Allen County (Indiana) could be tried in the township to determine its feasibility.

Farm Chemical Use: Fertilizer

The average rate of phosphate application to corn in Venice Township is about 35 lbs. P per acre. This is a higher average rate than recommended rates of 13-22 lbs.P/acre (Table 2-2). This range varies with the level of plant-available soil phosphate. The average available soil phosphate in Seneca County in 1971 was 33 lbs.P/acre which means that, on the average, application rates for corn need only be 20 lbs. P per acre. Thus, on the average, Venice Township farmers are applying almost twice the amount needed for the maintenance dose that corn requires. A similar situation applies to wheat. The average rate for wheat is 31 lbs.P/acre while recommended rates are 18 to 29 lbs.P/acre (buildup rate) depending upon existing soil levels. Application of buildup rate between 1961 and 1971 has increased available soil phosphate levels dramatically in the Ohio portion of the Lake Erie Basin. Figure 3-3 shows this trend. The implication of this trend is that fertilizer rates for phosphate can be significantly reduced to maintenance levels without affecting yields on many farms in the township. Soil testing can be used to insure proper fertilizer blends.

Average nitrogen fertilizer application rate for corn is about 100 lbs./acre (N). The average corn yield obtained is 110 bushels/acre. This average yield is what can be expected from the average fertilization rate although CES data indicate that higher yields might be obtained by increasing nitrogen rates.

In Venice Township there are two periods of fertilizer application: September-November and April-May. A few farmers apply fertilizer outside these periods in late winter. Top-dressing and broadcast application without immediate plowdown should be minimized during

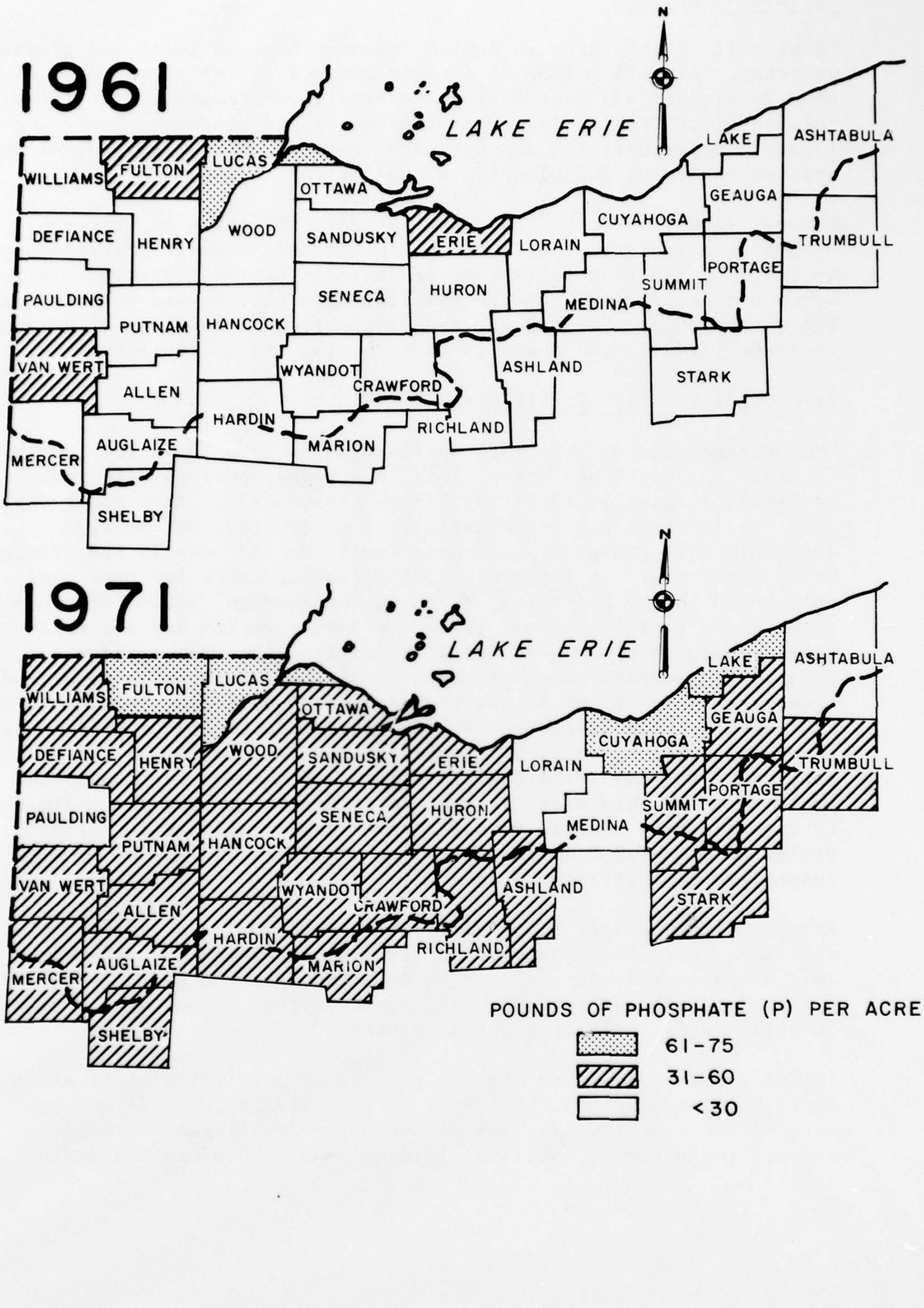

1961
LAKE ERIE
N
WILLIAMS
FULTON
LUCAS
OTTAWA
WOOD
SANDUSKY
ERIE
LORAIN
CUYAHOGA
LAKE
GEAUGA
ASHTABULA
TRUMBULL
PORTAGE
SUMMIT
MEDINA
DEFIANCE
HENRY
PAULDING
PUTNAM
HANCOCK
SENECA
HURON
VAN WERT
ALLEN
WYANDOT
CRAWFORD
ASHLAND
STARK
RICHLAND
HARDIN
MARION
MERCER
AUGLAIZE
SHELBY
1971
LAKE ERIE
N
WILLIAMS
FULTON
LUCAS
OTTAWA
WOOD
SANDUSKY
ERIE
LORAIN
CUYAHOGA
LAKE
GEAUGA
ASHTABULA
TRUMBULL
PORTAGE
SUMMIT
MEDINA
DEFIANCE
HENRY
PAULDING
PUTNAM
HANCOCK
SENECA
HURON
VAN WERT
ALLEN
WYANDOT
CRAWFORD
ASHLAND
STARK
RICHLAND
HARDIN
MARION
MERCER
AUGLAIZE
SHELBY
POUNDS OF PHOSPHATE (P) PER ACRE
61-75
31-60
<30

FIGURE 3-3

the fall-winter period to avoid nutrient losses to streams during winter rainstorms and snowmelt events. The high soluble phosphate loads lost from the watershed during the rainstorm/snowmelt period (see Table 1-2) are probably derived from fertilizer applied after the previous fall's harvest but inadequately incorporated into the soil. It is recommended that broadcasted fertilizer be plowed down as soon after application as possible in conventionally cultivated fields. For conservation tillage practices, in which plow down is not possible, fertilizer application should wait until planting time.

Pesticide Use

Herbides

The herbicides most commonly used in Venice Township are Atrazine and Banvel (Dicamba) for corn, Lasso (Alachlor) for corn or soybeans, Lorox (Linuron) for soybeans and 2-4D for oats and corn. They are used against a variety of broadleaf weeds and grasses including quackgrass, foxtail, ragweed, and thistles. To protect water quality and the health of livestock and human crop consumers herbicides used should have a low persistence in soil, a low toxicity to fish and should attach to soil particles rather than be carried by water. These properties of the above herbicides are shown below.

Herbicides used in Venice Township	Approximate Persistence in soil (days)	Carried by	Toxicity to Fish LD_{50} in mg/l[1]
Atrazine	300-500	Soil & water	12.6
Banvel	-	Water	35
Lasso	40-70	Soil & water	2.3
Lorox	120	Soil	16
2-4 D	10-30	Soil & water[2]	4.5 to 50[2]

1. LD_{50} in mg/l is the strength of a water solution of a substance that will kill 50 percent of test fish in 48-96 hours. A milligram (mg) is 1/28,000 of an ounce; a liter is slightly larger than a quart.

2. Different depending upon acid, ester or amid forms of 2-4D.

Atrazine is the herbicide that is potentially the most threatening to water quality due to its 300-500 day persistence in soil, its toxicity to fish and its tendency to move with water. Individuals should check periodically with the Cooperative Extension Service or Ohio State Department of Agriculture to determine if there is available a substitute for Atrazine that is less hazardous. The choice should be a herbicide that attaches to soil particles and degrades more quickly.

Insecticides

Corn is the only major crop significantly affected by insect pests. The wireworm, cutworms, and rootworms are the targets of Furadin (Corbofuran) and Heptachlor in Venice Township. Usually, these insecticides are used to treat the corn seed before planting or are placed in soils as crystals in the seed row. Such local application requires a minimum dose and as such the threat to water quality and the health of crop consumers is minimized.

Management of Livestock Wastes

In Venice Township, livestock operations are concentrated with a few producers. It is estimated that 10 - 15 farms raise more than 90 percent of all livestock for marketing. Beef and swine feeders are the most numerous followed by swine breeding herds, sheep and dairy cattle. Most beef and swine feeders are raised indoors and their wastes either applied directly to fields or stored under a roof. About half the sheep are pastured but are fenced from streams and channels. The dairy herds are put to pasture in summer and likewise fenced from streams. About half of the non-feeder swine are in pasture and a few are not fenced from streams.

It is concluded that manure management practices in Venice Township are almost fully consistent with water quality goals and little opportunity for improved management exists, apart from some needed fencing of livestock from streams.

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